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PROSPERITY AND ILLUMINATION.

The demand for incandescent lamps and current to feed them has been very heavy during the past winter, and it has been generally attributed to the prosperity of the well-to-do public and to the greater multiplicity of entertainments. Lately, however, much surprise has been expressed at the extraordinary largeness and continuance of the calls for arc lamps. As a usual thing, the orders for arc lamps fall off with the close of Christmas trade and the beginning of the new year. This season, the orders have been renewed since January time and again, and even now in March we hear of big orders being placed. It has been shrewdly suggested, and inquiry would go to confirm the notion, that this unwonted demand for arc lamps is due to the fact that mills and factories of all kinds in all parts of the country have been compelled by the pressure of work to run nights and have needed more light than ever before in their history. We are glad to note such conditions, and trust they may long continue.

MUNICIPAL ENTERPRISES.

We are sure that every one will read with interest the article in this issue which sums up the results of the attempts made in Boston to carry on a municipal electrical construction bureau. It will not cause any wonder that a department administered so extravagantly should be suppressed. There was no other way out. When a private contractor submits an estimate for $40 and the work done by the city for itself costs $300, the case against municipal control is presented "in a nutshell." Anybody can understand that kind of an argument. Yet Boston has had other experiences of this kind, such as that with ice which when fetching $3 per ton in the open market cost the city nearly $60 a ton when procured through the municipal department.

Such cases as these more than offset the occasional instances of economy due to the self-sacrificing efforts of some devoted public official, but the old delusion lingers, that governments can do commercial work better than citizens. We have a curious example of this superstition lying before us at this very moment. The Paris newspaper *Le Matin* has a strong editorial devoted to the advocacy of government ownership of submarine cables, not apparently because France really needs them but because other countries seem to be going in for them and because they are cheaper under government than when in private hands. On the very same page is printed a biting, sarcastic attack on the matches manufactured by the state, winding up as follows: "The state defends its citizens against theft, but who shall protect its citizens when the state is itself the thief?" The articles abuses the matches made by the government in good round terms, and compares them very unfavorably with the matches made in neighboring countries by those who are just plain private manufacturers. We think we must leave the *Matin* to chop its own logic. It is a little beyond us.

LIGHT TRACTION.

Now that the trolley has conquered the street railway it is beginning to invade the steam railroad, but it would seem that at the other end of the scale of transportation there is an equally vast domain awaiting occupation by electricity. Not long ago we called attention to the remarkable possibilities of telpherage, a long neg-

lected art. This week we describe and illustrate some very ingenious work in France based on the driving of an automobile by the live current from the line wire. Some such work has been attempted before, but in this instance there is the novelty of placing an auxiliary small motor in the trolley itself.

Here again is another field of effort to which American inventors long since directed their thoughts and efforts, and which is certainly worthy of cultivation. In addition we have the traveling stairway and the moving sidewalk, both of them capable of wide use and adaption. But if to some persons these uses should appear to be still literally and figuratively "in the air," there remains the promising and attractive department of narrow gauge work. It is really difficult to tell why this has received so little attention and has been left so long to steam, but the chief reason probably is that electrical manufacturers have been more than occupied by the claims of the street car line and heavier cross country roads for apparatus. But it should be easy for newcomers to annex this field of work, and we shall be greatly surprised if this is not done at an early date. More than ever in industry, intercourse and agriculture is the need felt for such methods of electrical transportation.

The Sociology of Telephony.

The discussion of the effect of long distance telephony on train service and the use of hotels has somewhat familiarized the public with the idea that the telephone is having various effects on social life that were not at first suspected. But the continuing developments of this character are of a surprising nature. For example, few habits are more ingrained in the commercial and business man than that of meeting on 'change. The practice long antedated railroads, and has been common among all civilized peoples. But now it would appear that having learned to make extensive use of the telephone while at the exchange, brokers are now neglecting business on the floor and are transacting it more and more directly from office to office by the telephone. It is said that this practice is gaining ground to such an extent that the exchanges in some lines of trade suffer quite appreciably.

So much for trade in the bulk. It is also said that the cotton growers themselves are benefiting by the high prices this year to an unusual extent because of the greater telephonic facilities they are now enjoying. This, if true, simply confirms the recent statement as to some transactions in the broom corn district of Illinois. Buyers from outside began to clean up the broom corn at $60 per ton, when a telephone official called up the farmers on his system and told them the market was rising rapidly. The result was that before the season ended they had sold their crop at $240 per ton. Telephones would be cheap at any price anywhere on such terms, and it is the fact that the value and benefit of the service are not yet by any means appreciated.

The Curvature of Spiral End Connections.

In the older type of multipolar direct-current drum windings, using spiral instead of straight-out end connections, the exact curve to be followed by the conductors is a difficult point to determine. As is well known, the curve is theoretically an involute, and the principal point of difficulty is to determine the diameter of the generating circle of this involute. For good electrical properties the end connections should of course be as nearly straight from slot to slot as possible, in order to reduce the ohmic resistance, weight and cost of the armature. This requires that the two involutes forming one end connection (assuming a wave or series winding) should approach as nearly as possible the line of a straight chord connecting the ends of the slots carrying the coil. The chief requirement of the involute, however, is that it should be such a curve as to pack the end connections tightly together so that there would be no freedom for vibration and rubbing when the armature is in motion. By making the generating circle of the involute large the connections will be packed tightly, while by making it small they will be allowed more space.

In last week's issue Mr. Chas. G. Simonds gave a graphical method of determining the diameter of the generating circle. The determination is based on the provision of proper space for the connections, and is therefore dependent on the ratio of the thickness of the end connections, including the insulation, to the tooth pitch. The first quantity is a variable factor, depending upon the tightness with which it is desired to pack the connections, and is difficult to determine owing to the non-mechanical nature of the materials, the dimensions of which are desired. The two dimensions, viz., the thickness of the connections and the polar pitch, are both small ones and the slightest error in the graphical construction makes a considerable variation in the result, so that the method is of doubtful value, except as a rough means of determining somewhere near what the desired curve is, a more exact determination being only possible by experimenting to find just how closely the winding is packed together when assembled.

A National Laboratory.

An interesting article by Dr. Wolff in another column shows that the U. S. Office of Standard Weights and Measures in Washington is already prepared to standardize certain pieces of electrical apparatus. It is only a question of time when a national laboratory will exist in every country of importance, for the checking and calibration of all important apparatus connected with electrical engineering. The time will perhaps come when the fundamental physical standards in concrete form will be considered as much the Lares and Penates of a nation as its historical relics. In the ordinary affairs of life we are so absolutely dependent upon our units of length, mass and time, that we are apt to forget the immense labor that has been necessary to maintain these units. A concrete unit of length is usually prepared as the distance between certain scratches on the surface of a metal bar, at a certain temperature, and the concrete unit of mass is always prepared in the form of a lump of metal. Both these units are readily preserved in boxes and are as nearly invariable as anything at the bottom of a sea of air on the surface of a planet can can well be. But there is no concrete unit of time. For that we are dependent upon the angular velocity of the earth, and for the adjustment of clocks to synchronize with some definite fraction of the earth's angular velocity. In electrical units somewhat similar conditions are to be found. A concrete unit of e. m. f. exists in the form of the Clark cell, and a concrete unit of resistance in the form of a prism of metal, but there is no concrete unit of current that can be stored away for preservation, and current strengths can only be reproduced by reproducing their electrochemical or electromagnetic effects.

The importance of maintaining a carefully safeguarded set of standard physical units is partly of a scientific and partly of a practical nature. No good work can be done in the exact sciences without definite units, and the work of to-day has no comparison with that of yesterday or of to-morrow, unless these units are preserved and compared. Moreover, in a universe whose actions seem everywhere to be closely associated with change in everything, it is quite possible that in the course of time the most fundamental quantities,

such as the intensity of gravitation, velocity of light, or the speed of ions in electrolytes may undergo variation. It is conceivable that the very ether which pervades all things may vary in different parts of the universe or at different times in the same part of the universe. There is no likelihood of our having small secular change of such a character brought to our notice unless our fundamental units are carefully preserved.

For all scientific purposes, the utmost possible care and precision in measurement and comparison are none too great. Every decimal place that can be reached with certainty is so much gained from the land of the unknown. The discovery of any variation with time in the magnitude of the physical conditions by which we are surrounded might be of the greatest importance to the race. From a practical point of view, however, a set of standard physical quantities is only necessary for engineering purposes, using that term in the broadest sense. In the great majority of instances a very high degree of accuracy in electrical engineering is not necessary. In land surveying a high degree of accuracy is necessary, because a lawsuit may arise over a strip of land a single inch in width, but in the case of electrical measurements for light or power distribution, one per cent. of error in an indicating instrument is usually too small to be worth much expense in correcting. If a station ammeter or voltmeter on the switchboard of a power house is inaccurate in its readings to the extent of one per cent., it is usually of very little practical importance, and the reading instrument of this kind found on a switchboard is usually inaccurate by more than one per cent. and in some cases by a dozen per cent. In voltmeters a higher degree of accuracy is ordinarily necessary than in ammeters, because a variation of one per cent. in the voltage to which incandescent lamps are subjected has a marked influence upon their luminosity and lifetime.

What is wanted in aid of electrical engineering is a national laboratory at which all measuring instruments can be calibrated or checked, and the charge made for this work should depend upon the degree of accuracy required. Thus the reading station switchboard voltmeter should only be calibrated to within, say, one-half of one per cent. and a station ammeter to within one per cent. unless specially desired. Portable measuring instruments should be more carefully rated and at a correspondingly increased charge. A portable voltmeter should be capable of being checked to within a quarter of one per cent. and an ammeter within half of one per cent. Again, secondary standards for laboratory purposes should be capable of being checked to within still closer limits. In each case the expense of calibration should bear a reasonable ratio to the importance of the instrument. It is waste of money to make station instruments too nearly accurate, and also waste of money to construct delicate standard instruments unless they are calibrated to the full extent of their permanence and reliability.

It is reasonable to expect that both the scientific and the practical or commercial type of standardization or checking of units can be carried on at the same laboratory in different departments. It is hopeless to expect to do both scientific and commercial calibration in one and the same department, because the routine work must constantly interfere with measuring research and *vice versa*. But the training and preparation for routine calibration fits observers for the scientific work, while the knowledge gained in the scientific work is valuable and immediately applicable to the routine measurements. The range of measurement required in any system of checking the calibration of commercial apparatus is very considerable. Resistances must be compared between the limits of, say, one microhm and one megohm. Currents between a fraction of the milliampere and perhaps 100 kiloamperes, electromotive forces between a fraction of a millivolt and 200 kilovolts, wattmeters from a few watts capacity up to many kilowatts capacity and so on. This would probably entail several sets of apparatus for one physical quantity.

Another set of calibrations urgently needed is in the direction of photometry. Resistances can be compared, as stated by Dr. Wolff, to within 1-500th of one per cent., or one part in 50,000, but incandescent lamps are frequently several per cent. apart in their measurement by different observers. Photometry is unfortunately still dependent upon the human eye for its measurements, and does not depend at present upon the indications of a simple measuring instrument external to the eye. So long as matters remain in this condition, it is desirable to have the same personal equation introduced into each measurement, and to have all substandards of incandescent light, i. e., all standard incandescent lamps, compared with one and the same fundamental standard. This can be accomplished by having fundamental standards issued at some one laboratory, say, in Berlin, and copies distributed to national laboratories, which in their turn should issue secondary standards for general distribution. By this means if the measurements all over the engineering world were not quite correct, they would at least be affected by substantially the same error. The existing variation is not to be traced to the comparison of any two incandescent lamps, because the lamp to be compared and the standard lamp have approximately the same color and spectrum. The difficulty is met in the original calibration of the standard incandescent lamp in terms of the fundamental standard, and is due to the difference in color between the fundamental standard and the incandescent lamp. Once an incandescent lamp has been standardized it can be copied thousands of times with very little inaccuracy by ordinary care, but ask three different observers to determine the candle power of the standard incandescent lamp in terms of the carcel or Hefner-Alteneck or other fundamental standard, and their observations will probably differ markedly; while there is no means of absolutely determining which observer is correct.

For several years past the American Institute of Electrical Engineers and the National Electric Light Association have had under consideration the question of incandescent lamp secondary standards, the provision of which from an authoritative source has been a crying need of the electric lighting industry. Committees of the first mentioned society have made a careful study as to the requirements of such a standard, methods of standardization, etc., but the work has been brought to a halt owing to no satisfactory means offering whereby lamps could be standardized and supplied to the industry. It is probably true that arrangements could be made to have the work undertaken by a college or university laboratory. The objections, however, which have been offered to this solution are that an undue prominence, which would be resented by other institutions, would be given to the laboratory selected for the standardization work; and it has been felt that the work should be undertaken by a body having a truly national character. For this reason it has been urged upon the American Institute of Electrical Engineers to undertake the work, but many objections have been found against that body embarking on an enterprise so foreign to the purposes for which it was organized. An ideal solution is offered through the present extension of the work of the Office of Weights and Measures, and we most sincerely hope that means will be found to enable that office to furnish incandescent lamp secondary standards to the electrical industry. The suggestion is not, of course, a novel one, for a much appreciated part of the work of the Reichsanstalt in Germany has been to furnish such standards, not only to Germans, but to any one who makes application.

The Recent Erie Telephone Deal.

It is only natural that the recent acquisition of the Erie Bell telephone system by the "independent" Telephone, Telegraph & Cable Company of America should continue to be an all-absorbing topic of conversation in telephonic circles. Many of those who are affected by the change of ownership do not know which side of the fence they are on, and no little anxiety results. Mr. Henry A. Everett, president of the Federal Telephone Company, of Cleveland, which among other independent telephone properties controls that of the United States Telephone Company and the Cuyahoga Telephone Company, when asked what effect, if any, the purchase of the Erie Telephone property by the Telephone, Telegraph & Cable Company of America would have on the telephone interests he represents, said: "I desire to make this statement: The property of the Erie Telephone Company, including the plant at Cleveland, has always been dominated by Bell influences and hostile in every particular to the independent interests; therefore under no circumstances could a change of ownership in the Erie property have any bad effect upon us, even though its present ownership should work in harmony with the Bell interests. The Telephone, Telegraph & Cable Company owns no telephone property in the East, and simply controls the stock in two other Eastern companies recently incorporated, and neither of which owns or operates any telephone property anywhere, so that as a matter of fact, the recent deal does not consolidate, tie up, or affect any telephone property except that formerly owned by the Erie.

"Of course I do not know what policy will be pursued by the new management, but I do know that it cannot be any more antagonistic than the past management has been. The independent telephone people of Michigan, Indiana, Ohio, Pennsylvania, Maryland, and other adjacent states have a perfect understanding and are working in complete harmony with each other. In Ohio approximately one hundred and fifty independent telephone properties are connected with each other and like properties in adjacent states by means of the first class, full copper metallic, long distance lines of the United States Telephone Company, and in the states above mentioned like systems are being developed and operated in perfect harmony, so that the present summer will see in full operation the most complete and comprehensive telephone system in this territory which this country has ever known. As before stated, if the Erie system should still be quietly operated as an adjunct of the Bell system, one reason for the property passing into apparently independent hands would probably be to try to relieve it from the odium of being a Bell concern. On the whole, if the recent deal has any effect on our interests it will be a beneficial one."

Vice-President McKinstry, of the Cleveland (Bell) telephone system, says that he has no reason to believe that the purchase of the Erie Telephone Company by the Telephone, Telegraph & Cable Company of America will make any difference with his position. He has not been notified of any change. There have always been two vice-presidents of the company, and there has never been any distinction between them as to which was first or second vice-president, each having his sphere of work. The election of Mr. Adams as a third vice-president to represent the interests of the new owners in the Erie company does not, he thinks, necessarily imply any particular changes. Mr. Adams was a director of the Erie company and of the Cleveland company for a number of years until about two years ago. "We don't care what attitude the Telephone, Telegraph & Cable Company of America takes toward the Bell interests," said Mr. McKinstry. "They may help us and I am pretty sure they will not hurt us."

Pittsburg Municipal Electrical Department.

In a recent annual report Mr. Morris W. Mead, superintendent of the Bureau of Electricity of Pittsburg, gives an account of the extension of service during the year. The fire alarm boxes have been increased from 200 to 453 and an entire new police telegraph system put in, comprising 198 booths and boxes. In the business portion of the city the municipal wires have been placed underground in cables, rubber insulation being entirely used. During the year a system of thorough inspection of electric light wiring in buildings has been put in force, and the entire overhead wire system has been replaced with insulated copper wire and increased from 500 to over 1100 miles of conductor. The entire telephone system including those in police boxes has been transformed to the metallic system. During the year also the inspection of all kinds of dangerous and faulty construction of wires, underground and overhead, which might lead to accident or injury, has been added to the jurisdiction of the bureau. But one fire during the year has been reported as having been caused by electric light wires. The recommendation is made that no electrical wiremen be permitted to exercise their calling unless they have been examined and licensed by the city authorities. A number of improvements have been introduced in the fire alarm service, both relating to the regular firm alarm system and a telephone adjunct. The use of the storage battery for fire alarm purposes is very highly commended as the result of experience in Pittsburg during the past three years. The work of the Electrical Bureau includes the care and maintenance of the fire alarm and police telegraph systems; inspection of all electric light wires in buildings; practical electrical engineering work for all department buildings and advisory service in many outside cases for safety purposes; the care, construction and maintenance of all telephone call systems for the department, and supervision of all overhead and underground wires for safety purposes.

Some Recent Independent Telephone Work.

Regarding the plans of the independent telephone companies at Baltimore, George R. Webb said, in a recent interview: There has been some delay owing to the difficulty in securing building material, but this no longer interfered with the work, and the top floor of the central exchange will be ready for the installation of the switchboard in about five weeks. The pole lines, covering the entire city outside of the subway district, are practically completed. The stringing of the overhead wires and the drawing of the cables into the city subways will be started in a few days and it is hoped to have the entire system completed not later than June. Including the substations, the total capacity will be 7200 telephones. The plans of the company contemplate reaching all of the principal suburban towns, and the pole lines of the United Railways & Electric Company may be used for this purpose.

As to the progress that is being made in other cities, Mr. Webb said: "The progress of the work of the company in Pittsburg has been most satisfactory, although but eight months have elapsed since the work began. We have over 4000 subscribers and have completed about fourteen miles of our own subways in Pittsburg. One line of subway is about six and one-half miles in length. Over ten miles of pole lines are completed. The main exchange building, costing over $100,000, located in the heart of the city, is fast nearing completion, and the installation of the switchboard will commence in about ten days. The central exchange will have a capacity for about 4500 telephones, and with the exchanges being built in what are known as the Bellfield, East End and South Side districts, there will be a combined switchboard capacity for about 7700 telephones. The switchboard in Allegheny, containing 2500 'drops,' will increase the total capacity of our lines in the cities of Pittsburg and Allegheny to about 10,200 telephones. Already about 25,000 feet of 250-pair cables have been drawn into the subway and about 178 prominent buildings have been wired for service. It is expected that when the plant begins operations, which will be about June 1, the company will have between 5000 and 6000 telephones in actual use. With the outlying districts connected up this number will be largely increased, and at least 10,000 telephones will be under contract by the first of the coming year. The subways were planned to take care of the future, and the ultimate capacity is 20,000 telephones.

In speaking of the plans of the Washington Telephone & Telegraph Company, which is also controlled by the same syndicate, Mr. Webb said: "Although Congress has not yet passed the company's franchise bill, contracts for over 1600 telephones have been secured. A unanimous report has been made by the District Commissioners recommending to Congress the passage of this bill. Resolutions urging favorable action have been adopted by many of the business organizations. Immediately upon the requisite authority being given to our company the work of construction will be commenced, as all the preliminaries have been arranged. The plant in Washington will be connected by independent long-distance lines with the plants of the United Telegraph & Telephone Company, which is the parent corporation, with exchanges in Baltimore, Wilmington and Pittsburg. Other long-distance connections are now being arranged and will be announced at a later date."

Cincinnati Walnut Hills Telephone Exchange.

By H. E. Hall.

THE rehabilitation of the entire telephone service of Cincinnati, beginning with the Walnut Hills Exchange, marks an era in the history of one of the most conservative and successful telephone enterprises in the United States. Not that the Cincinnati service is so extensive nor yet so widely known; it is neither of these, but is strictly an independent concern, and, according to Mr. George N. Stone, president and general manager, it will remain so. This company has successfully fought off all competition and all efforts of consolidation since its organization in the spring of 1873 as the City & Suburban Telegraph Association.

The annual meeting of the stockholders, held in February, showed the company to be in a flourishing condition. At the end of the year there were 6905 subscribers, an increase of 1049 stations. All the wires have been placed underground in the business part of the city and there has been laid a total of 22¾ miles of subway—a more extensive system than possessed by any city in the United States of equal importance. The gross earnings for the year were $572,840.82; the gross expenses $375,178.55, leaving net earnings of $197,662.27. The extension of the subway system to practically all the suburbs was decided at this meeting.

The Walnut Hills Exchange branch is taken as an example of the improvements now under way in Cincinnati because it is the first to receive the benefits of the common-battery relay-switchboard system, as it was the first to be equipped with the multiple-metallic circuit board in 1890.

At the Walnut Hills' exchange a storage battery plant of eleven cells of two volts each, furnishes current for operating the exchange. The battery is charged from a 3-hp dynamotor, the motor end receiving current from a 500-volt power circuit, and the generating end delivering current at 30 volts for charging the storage battery. These machines are in duplicate so that if anything happens to one, the other can be used. There are also two one-third-hp motor generators for furnishing current to the operating table for calling subscribers. One of these is a regular motor generator taking its current at 24 volts from the storage battery, and delivering from the generating side three different currents—an alternating current for ringing special lines, and

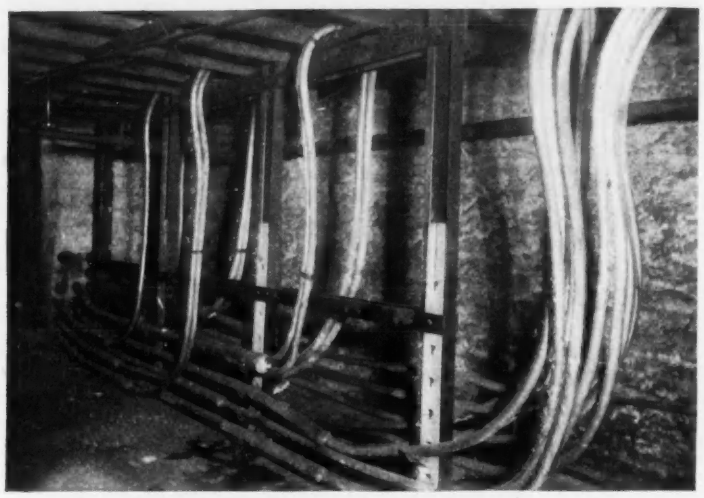


FIG. 1.—UNDERGROUND CABLES ENTERING BUILDING.

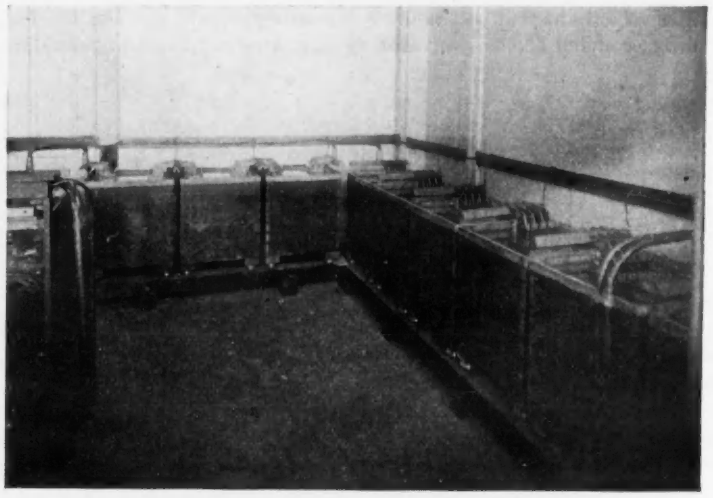


FIG. 2.—STORAGE BATTERY ROOM.

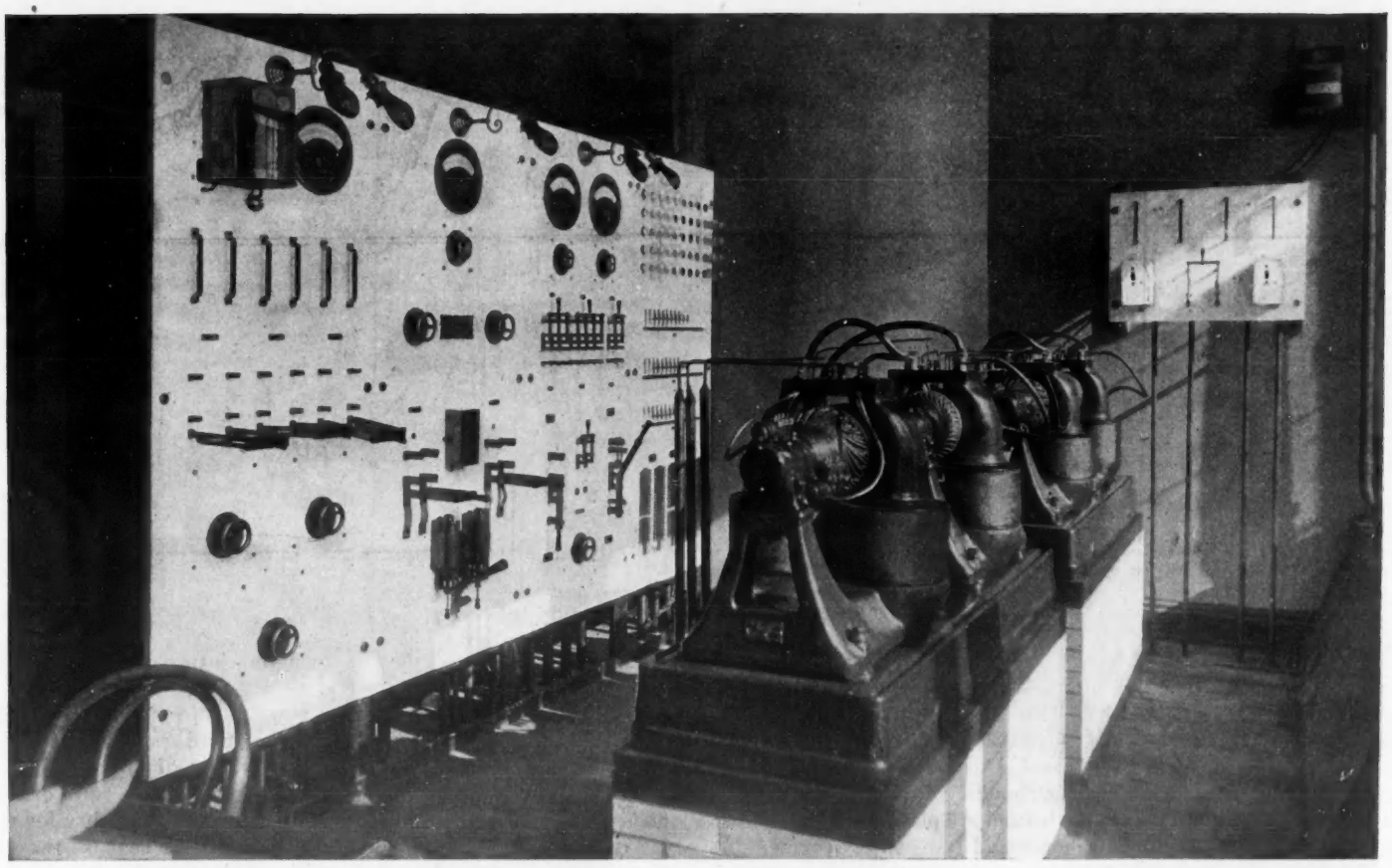


FIG. 3.—POWER SWITCHBOARD AND GENERATORS.

a positive and negative pulsating current for ringing selective signal party lines.

At the end of the shaft of this latter machine is a circuit interrupter in circuit with the storage battery and the primary of a transformer. The secondary of the transformer connects with the trunk operating tables and furnishes current for actuating the "busy back" and "don't answer" signals, the use of which will be explained later on. This interrupter is no part of the motor generator. It is simply an attachment on the shaft to facilitate the work of the operator in responding where the circumstances render it necessary to indicate "Don't answer" or "Line in use." The interrupter gets its current through the secondary field circuit of the storage battery.

The other small ringing machine differs from the one just described only in that the motor is separately wound and has its shaft direct-coupled to the generator by means of an insulating coupling.

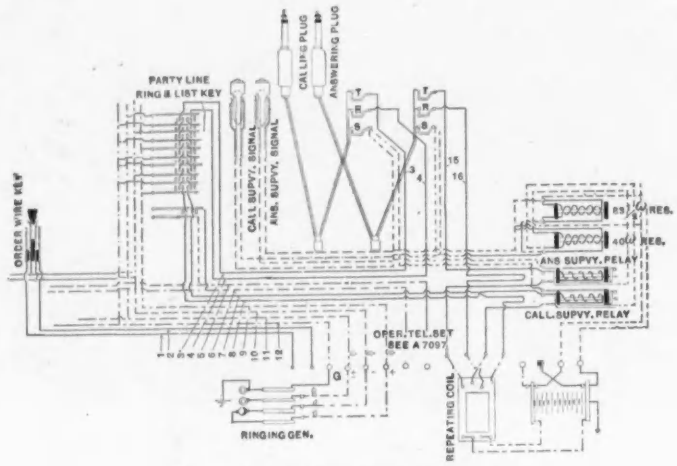


FIG. 4.—RELAY SWITCHBOARD NO. I.

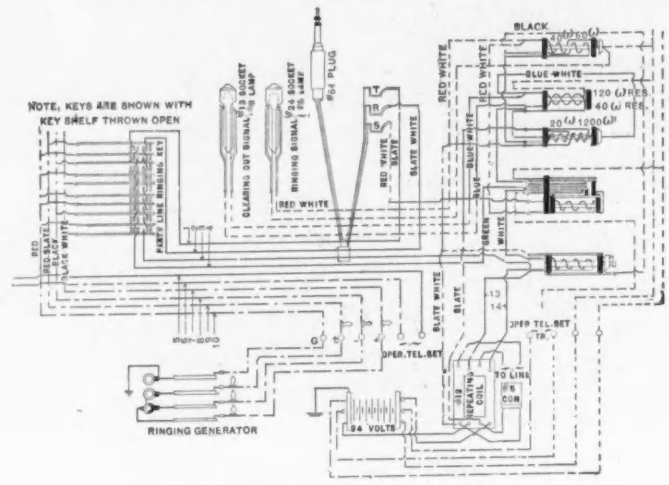


FIG. 5.—WIRING OF INCOMING TRUNK LINES.

The object of this arrangement is to prevent any high pressure currents from reaching the operating tables over the low pressure wires of the generator. This motor also takes its power from the 500-volt circuit.

The storage battery, as stated above, consists of eleven cells with ample room in each cell to add additional plates, should the growth of the plant demand it. It furnishes current to the subscribers for talking and for all calling operations.

The power switchboard is made of white marble in four sections. The first is a 500-volt panel containing a voltmeter, ammeter and the necessary switches, fuses and starting boxes to operate the motors. The second is a generator panel containing an ammeter, field rheostats, switches and a circuit breaker of the overload and underload type. The third is a battery panel containing one high and one low-reading voltmeter, with switches for testing the individual cells of the battery separately. This panel also contains generator switches, battery switches and starting boxes for the ringer motor generator. The fourth is a fuse panel. At the top is a bank of lamps used as a resistance in the ringing circuits, and below are the fuses of the third ringer current; at the bottom are placed the battery fuses on the line relays, supervisory signals and transmitter circuits.

The operator of the multiple switchboard, which contains 1600 subscribers' terminals, 50 incoming trunk terminals and 60 outgoing trunk terminals, is furnished with current from the storage battery plant. Each subscriber's line is furnished with a line relay and storage battery current connection to one side of the line.

Removal of the receiver from the hook at the subscriber's station closes the circuit and lights a small miniature lamp on the switchboard in front of the operator, giving the operator the signal. She then plugs in with the answering plug, which extinguishes the line lamp and puts her in communication with the calling subscriber. Upon receiving his number she takes the calling plug and asks the number wanted. Then there are two disconnecting signals operated by means of two auxiliary relays. When the conversation is finished and the respective receivers are placed back on the hooks, the two signal devices connected in the cord circuits light up the two lamps, thus giving the operator the disconnecting signal.

There are 25 incoming trunk lines to a trunk position, equipped with an elaborate set of relays so arranged as to reduce the amount of manual labor on the part of the operator to a minimum. One of the interesting features in the trunk system is what is known as the "busy back" and "don't answer" signals. When under the old system it was necessary that a subscriber's number be learned through another exchange and the line wanted was in use or did not answer, the subscriber would hear this message repeated back from a distant operator. Now when a call comes over a trunk line from one exchange to another and the distant operator finds the line in use, or no answer is made, she plugs the inquirer's line into a jack, when a variable buzz is heard corresponding to "line in use," and a slow buzz for "don't answer." The incoming trunk operator cannot talk to the subscriber; she uses the "busy back" in place of saying "line's in use" or "don't answer," thereby saving much time, which enables her to handle calls much more quickly.

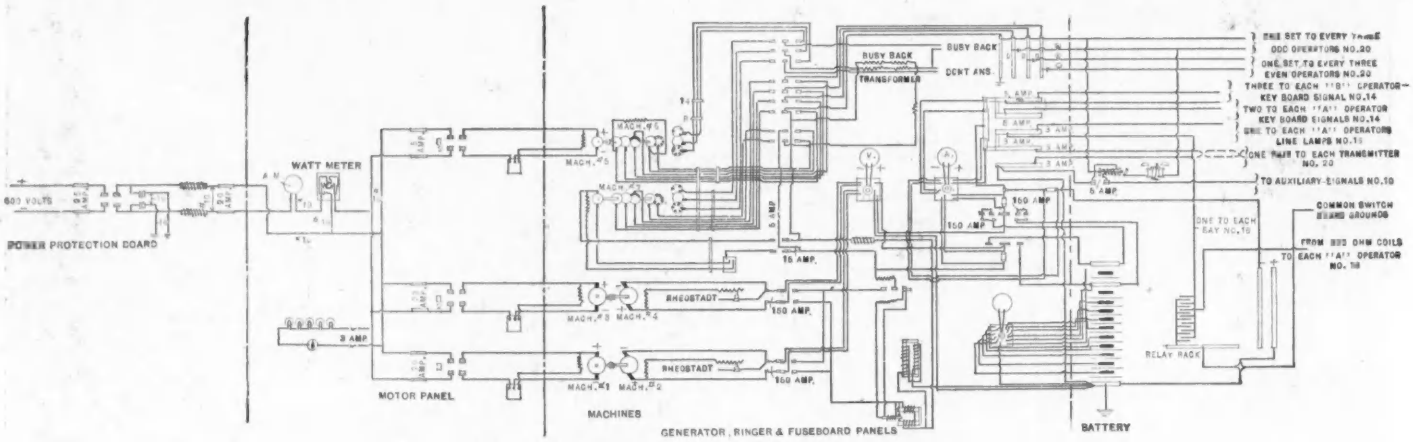


FIG. 6.—POWER CIRCUIT RELAY SWITCHBOARD.

One of the main features of the new system is the four-party line selective signaling. A line with four subscribers on each may be called or can exchange without the knowledge of the others on the line. Each operator's equipment consists of eighteen pairs of cords and plugs and each pair of cords has five ring keys, one key for ringing special lines and four keys for ringing selective signals—two positive and two negative keys. A positive and a negative instrument is connected to one side of the line and a positive and a negative to the

opposite side of the line, each instrument having a ground connection. When the operator wants to call a positive subscriber she presses on the positive current button, which sends out a positive current to ring his bell without interfering with the negative subscriber; or if the negative subscriber is wanted, she rings on the negative button on that side of the line. The other side of the line is operated in the same manner.

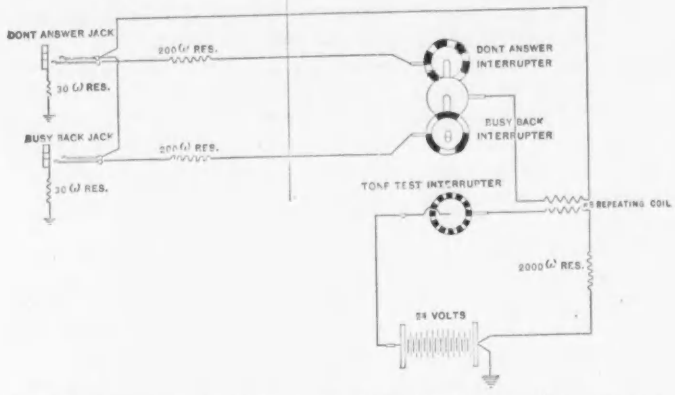


FIG. 7.—WIRING OF BUSY BACK AND "DON'T ANSWER" APPARATUS.

The wires entering the building, both ariel and underground, terminate on the horizontal side of a main distributing frame. The wires from the vertical side run to the switchboards. On the vertical side is mounted a protector which prevents sneak and high voltage currents from getting to the switchboards. It fuses at two and one-tenth of an ampere, thus opening the circuit and leaving it open between the main frame and the switchboards. The main frame is also used for a testing station to locate trouble between the switchboards and the outside terminal. The connection between the horizontal and vertical strips is made with a pair of wire twisted together, commonly called "jumper wire."

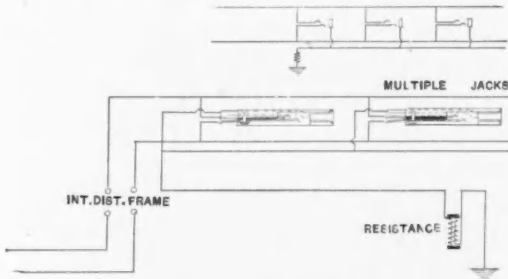


FIG 8.—WIRING OF OUTGOING TRUNK LINE.

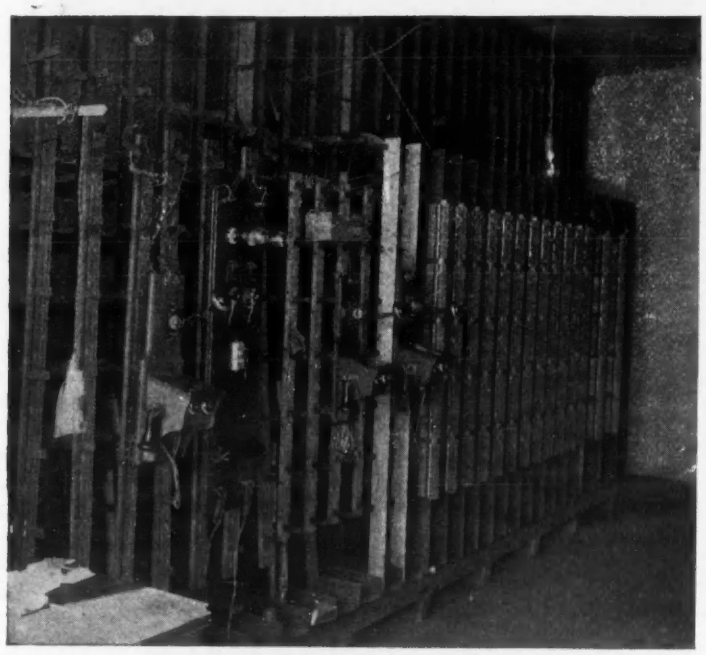


FIG. 9.—MAIN DISTRIBUTING FRAME.

The City & Suburban Telegraph Association was, as previously stated, incorporated in the spring of 1873, with the object of furnishing means of communication between offices and factories and in some city departments. In its earliest stages the telephone was substituted for the printing telegraph. The first switching apparatus was very crude—something like a Western Union plug board—and only one could talk at a time into the exchange. In January, 1879, the Blake transmitter came into use, a telephone switchboard was purchased and individual lines run to each subscriber. The company experimented with a great number and variety of switchboards at about this time. These were of necessity all more or less crude in construction and operation, until November, 1886, when the Cincinnati exchanges were consolidated and the lines run into the new central exchange in the Masonic Temple Building in Third Street and equipped with the Western Electric Company's new multiple board. One exchange was left at Eighth and Freeman Streets and another at Court and Broadway, but these were rebuilt very soon after. The metallic circuit board was next adopted (Nov. 1, 1890) because of the prevailing conditions which affected grounded line circuits. The old Broadway exchange was then abandoned and the new exchange on Walnut Hills—of which this article forms the subject—was established.

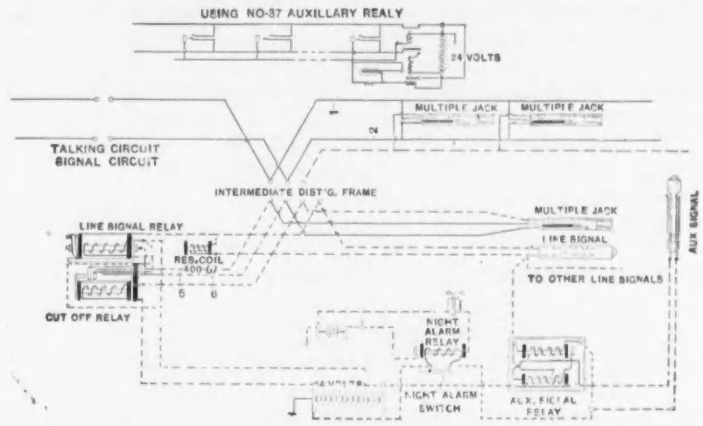


FIG. 10.—WIRING OF SUBSCRIBERS' LINES. RELAY SWITCHBOARDS NO. 1 AND NO. 2.

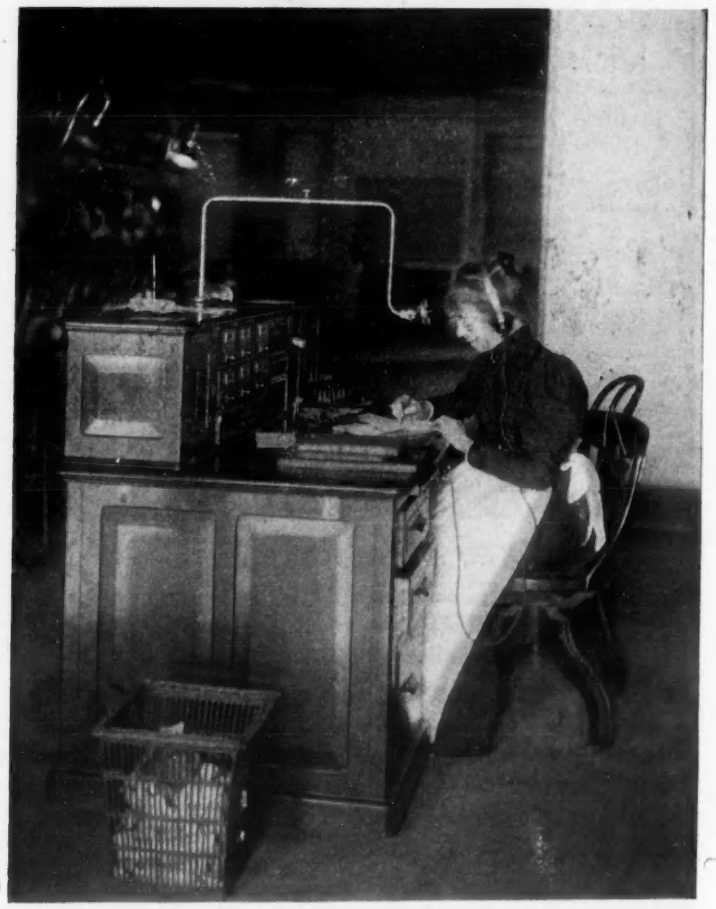


FIG. 11.—CHIEF OPERATOR AT HER DESK.

In the rehabilitation of the Walnut Hills exchange and the successful conduct of the company's business, no little credit is due to Mr. W. H. Robertson, the company's superintendent of construction. Mr. Robertson came into the service of the organization in 1879 as assistant to the then superintendent, John A. Seely, and in 1882 he was appointed superintendent of construction, and has had charge of the work ever since. The writer is indebted to him for the technical information contained in this article. The directors of the Cincinnati company are Messrs. Henry Hanna, C. H. Kilgour, George Bullock, John Kilgour, C. N. Stone and C. Jay French; the last-named gentleman is from Boston and represents the interests of the home office of the American Bell Telephone Company. Capt. George N. Stone is president and general manager, Mr. C. H. Kilgour vice-president, Mr. W. A. Blanchard secretary and Mr. John Kilgour treasurer.

Trolley-Fed Automobiles in France.

A TROLLEY-FED automobile system is now being experimented with in France on a line somewhat over half a mile in length on a road along the Seine just outside the limits of Paris, the inventor of the system being M. Lombard-Gerin. The principal difficulties encountered in such a method of traction is that two trolleys and two wires are necessary, and provision must be made for the vehicle to move a considerable distance from the route underneath the trolley wires in order to let other vehicles pass. M. Lombard-Gerin has made the trolley carriage itself an automobile, giving it speeds slightly greater at each instant than the vehicle. With this end in view, the double trolley is driven by a little non-synchronous induction motor of the squirrel-cage type, which is supplied with three-phase currents, produced by the motor of the vehicle. The armature of the latter carries on the side opposite to the commutator three rings connected to the armature winding at three points, displaced a third of the angle between two poles of the same name, thus drawing from the motor three-phase currents.

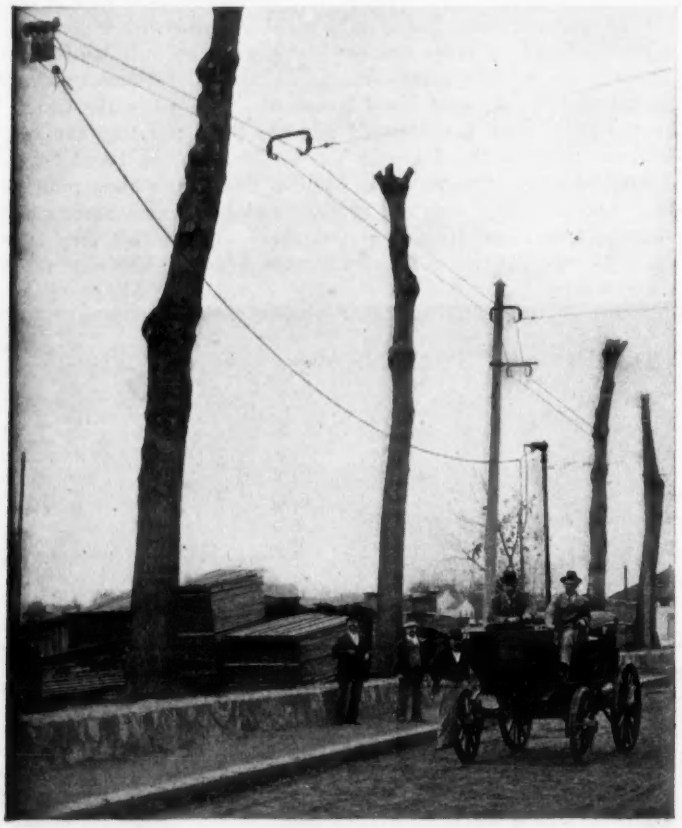


FIG. 1.—CARRIAGE EN ROUTE.

The double trolley, with its motor, stops when the principal motor stops, moves fast when the motor is moving fast, and follows in fact all the variations of the speed of the vehicle which it tends. Fig. 6 is a diagram of the connections of the motor and trolley.

In the experimental installation along the Seine, the aerial line is composed of two hard-drawn copper wires about No. 4-0 in gauge, from 20 to 30 feet above the ground and 12 inches apart. As will be seen in Fig. 1, these wires make abrupt turns, rise or fall, meeting, in fact, all the conditions imposed by the route. The trolley automobile is supported and guided by two aluminum wheels *G*, which lead the current to the carriage by means of a cable 25 to 30 feet long. The cable is composed of six conductors, of which two of large section lead the current from the trolley wire to the carriage, and the other four control the trolley motor. This cable is attached at the vehicle to a pole, the upper end of which is about 13 feet above the level of the ground. At the junction of the cable with the pole is a six-pole junction box, by means of which the carriage can be instantly disconnected from the line. All of these boxes are identical and interchangeable, so that when carriages going in opposite directions meet, they can continue their respective courses after exchanging trolley cables. By this means crossings may be made at any point of the line and with little delay.

The electric motor and controller, as well as the steering and breaking of the carriage, involve nothing especially new. In starting the series motor, starting resistances are cut out, as indicated by Fig. 6. On the other hand, the control of the trolley motor is worthy of special attention. On the armature of the vehicle motor are, as stated before, three rings electrically connected to three points of the winding, distant one from the other by the third of the angular separation of two field poles of the same name. The collectors of these rings are connected to three conductors, of which the other extremities connect to the winding of the stator of the little three-phase motor mounted on the trolley. The motor thus functions as a three-phase generator of variable frequency and e. m. f., the frequency and e. m. f. being low when the motor turns slowly and proportional to the speed of the vehicle at any instant.

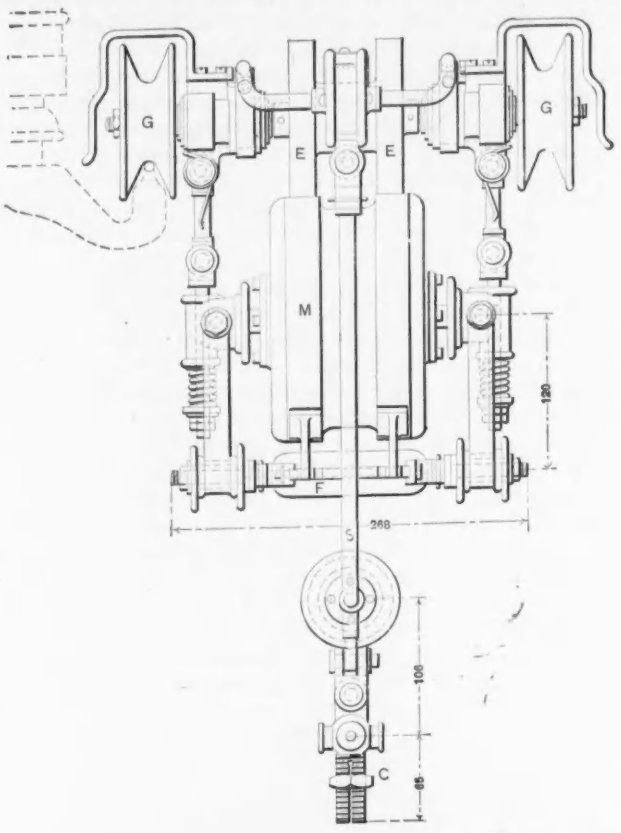
FIG. 2.—CARRIAGE TURNING OUT TO AVOID TEAMS.

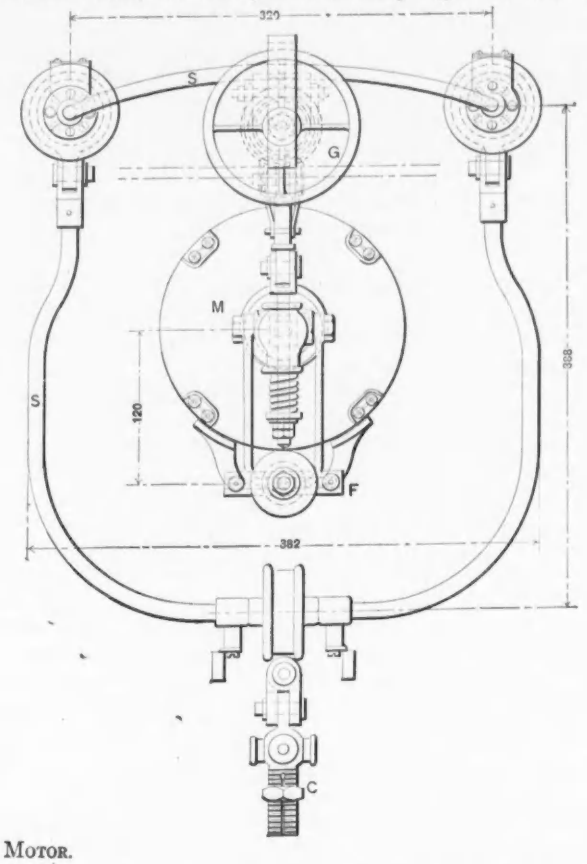
The three-phase currents thus produce in the trolley motor a rotary field of variable frequency and strength.

The squirrel-cage rotor, which is exterior to the inducing system, carries rims of steel *M* (Figs. 3 and 4), which engage with fibre wheels *E*, thus giving motion to the trolley wheels *G*, which drive the trolley with a speed which is theoretically at each instant a little greater than that of the carriage. This little excess of speed, however, is absorbed by the slip proper of the motor, the slip between the wheels *E* and the rims *M*, and finally by the slip of the wheels on the trolley. As soon as the trolley tends to exert the least tension on the cables it thereby increases the resistance offered and consequently the slips. The cable is flexibly attached at *C* through an articulation to a bridle, which latter is also articulated; the two right-angled articulations thus constitute a Cardan joint, which enables the cable to exert an oblique pull without tending to raise the trolley wheels from the wire and without affecting the motor, which remains suspended vertically by the action of its own weight.

The engagement of the wheels *E* and the rim *M* of the motor is regulated by springs, which permit the pressure to be varied. A reel on the vehicle permits the cable to be lengthened or shortened as the carriage approaches or recedes from the trolley side of the road. The motor is hermetically sealed and its mechanism, which, of course, does not include any electrical contacts, is secure from meddling. The trolley, which is entirely constructed of aluminum alloy except the magnetic parts, weighs only 40 pounds and absorbs scarcely 500 watts at its greatest speed.

As before stated, the trolley automatically regulates itself to the speed of the carriage, but an exception should be made in the case of a steep incline of the trolley wire, where it is necessary to stop its motion. The trolley would then have a tendency to slip on the wires and drop back, though the sag of the wire would tend to prevent this. To remedy this, an electromagnetic brake, *F*, is attached, the shoes of which normally just clear the motor. This brake takes its current from the trolley line through two large conductors, and is controlled by one of the six conductors in the cable mentioned before. To put the brake in action it suffices to depress a pedal in





FIGS. 3 AND 4.—TROLLEY MOTOR.

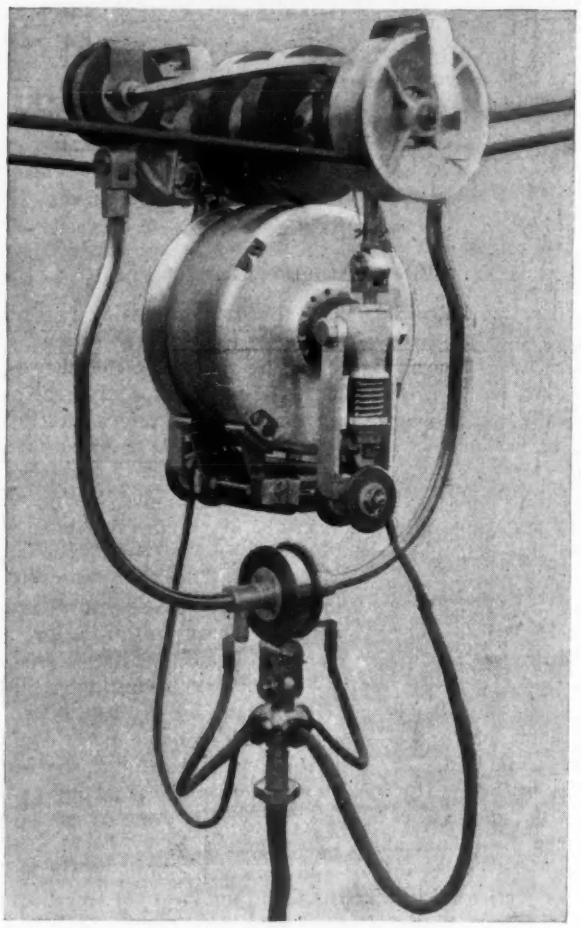


FIG. 5.—TROLLEY MOTOR.

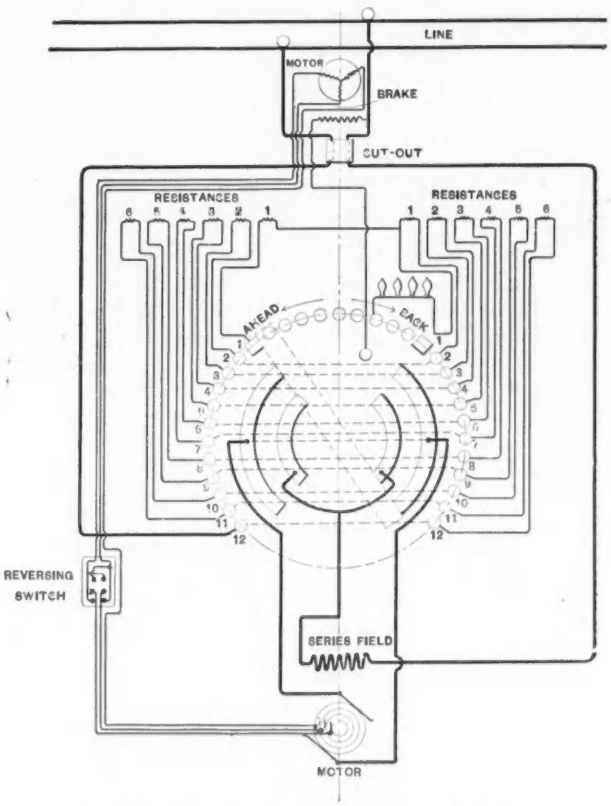


FIG. 6.—DIAGRAM OF ELECTRICAL CONNECTIONS.

the carriage, which throws into the circuit of the line the electromagnet operating the brake shoes.

To permit the trolley motor to move in either direction as desired, a pole-changing switch is included in the three-phase circuit, by means of which the connections of two of the conductors may be reversed, which reverses the direction of rotation of the rotary field and consequently the direction of motion of the trolley motor. The several ingenious details of the system noted give to it a great flexibility and ease of operation.

Prof. Hospitalier, the writer of the article in *L'Industrie Electrique*, from which this description is abstracted, considers that the applications of the system described are innumerable. The most evident consists in the economic extension of the service of existing lines of tramways to serve localities, the traffic of which is not sufficiently important to justify the extension of the main line. Trolley-fed carriages in this case would constitute secondary tramways, or economic subtramways. These aerial lines traversing the country would also place at the disposal of farmers a source of power for agricultural work, and thus create a new market for products of the electrical industry. In the case of a central generating station it will be possible to have lines extending to the suburbs, to railway stations, manufacturing works, etc., and thus create at little expense a new market for current. In most cases a potential of 220 volts will be sufficient for the service, and drop will be compensated for by reduction of speed in places distant from the central station.

Motors for Electric Automobiles.

By P. M. Heldt.

THE electric automobiles built in the early years of the automobile industry were provided with one or two encased motors built along lines which had been found most practical in motors for stationary and railway work. These latter motors had, at this time, been thoroughly worked out, and the attention of inventors working in the motor vehicle field was turned towards motor suspension, running gears, controllers and storage batteries. The question of single-motor equipment vs. double-motor equipment was then discussed a good deal, and as a result it is now generally conceded that neither the one nor the other holds the balance of advantages in every case, but that the special conditions of each case determine which of the two should be adopted. Of late the problem of driving the two wheels on one axle independently has received a number of new solutions, which will be described later on.

Lightness has long been considered a quality of prime importance in vehicle motors, and makers, in talking of their machines, often use the ratio of power to weight as a measure of merit. A reduction in weight of the motor permits a lighter running gear to carry the motor, and, if the distance to be covered by the vehicle remains the same, the storage battery required is lighter, and consequently also the parts of the wagon supporting the battery. The saving of weight on the whole vehicle is therefore a number of times the saving on the motor alone.

There is another quality of the motor, however, which also greatly affects the weight of battery required to propel the vehicle a given distance, or the distance which a vehicle can travel with a given weight of battery. This is the motor efficiency. Only that part of the storage battery energy which is usefully transformed into mechanical energy is applied in turning the wheels of the vehicle, and the distance the vehicle can travel depends upon the amount of this energy.

The rules in design which tend to reduce the weight of the motor to a minimum do not always increase the efficiency of the motor. While the use of electric and magnetic material of the highest conductivity affects both lightness and efficiency favorably, a variation of the ratio of copper to iron in the machine, or of the current density in the copper conductors, often affects these two qualities in opposite senses. It may be stated that a motor designed for minimum weight has a greater ratio of copper to iron than a motor designed for maximum efficiency.

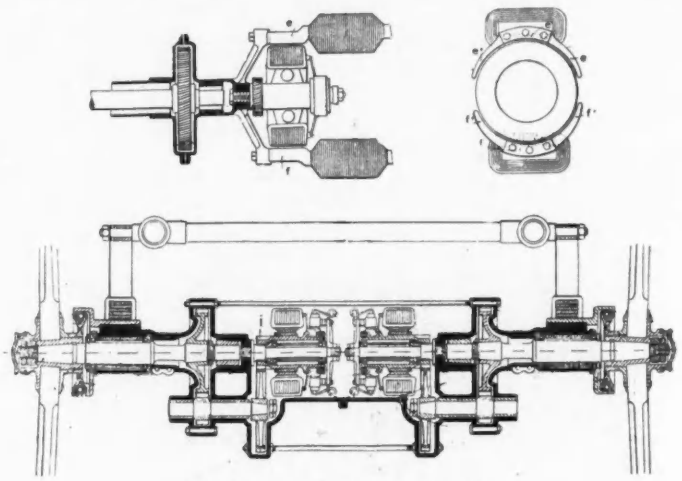
The problem before the designer consists in proportioning his motor so that a variation of the design one way or another would not permit the vehicle to travel farther with a given storage battery. To find the relation between efficiency and weight when this condition is satisfied, we must remember that the motor or motors usually represent about 10 per cent. of the weight of the vehicle complete with passengers or load. If, therefore, by a slight variation of the design, the efficiency is changed in one sense, and the weight of the motor in the opposite sense, and the percentage variation in weight is ten times the percentage variation in efficiency, then the original proportions of the motor were most favorable.

This consideration leads to heavier motors than have been used heretofore in the majority of vehicles. A motor of high efficiency also has a greater overload capacity, which increases the ability of the vehicle to climb grades. The importance of the efficiency of vehicle motors is fully recognized by many of the leading manufacturers, and the writer remembers a few recent occurrences where the efficiency factor was put forth as a coefficient of merit.

The field frame of vehicle motors is usually of the four-pole type, but two-pole motors have also been used. With single reduction, the angular speed of the motor has to be comparatively low. A low angular speed necessitates a large armature diameter, and with a large armature diameter a four-pole field frame is of lighter weight than a two-pole frame, other things being equal. With double reduction a high speed motor can be employed, and for a high speed motor a two-pole frame is best suited.

The first innovation in the construction of vehicle motors was to build the armature with a hollow shaft. The object of this construction is to avoid the divided driving axle by placing the differential gear on the motor shaft. The differential gear is fastened to the armature spider or the hollow shaft passing through it. The divided shaft passes through the hollow armature shaft, and has a pinion on either end, meshing with the gears on the driving wheels. This form of construction is employed by the Columbia Electric Vehicle Company and the American Electric Vehicle Company. Both firms place the differential gear inside the motor casing.

The differential gear is a somewhat expensive piece of mechanism and the divided shaft or axle used in connection with it is the cause



MONNARD AUTOMOBILE MOTOR.

of a good many difficulties. The alternative of using two motors, one geared to either drive wheel, is not free from objections, either, as the greater first cost, higher weight and lower efficiency of two small motors, as compared with one larger motor of equal output, are generally well known. Inventors have therefore attacked this problem in various ways and sought to obtain a more favorable solution.

One of the simplest solutions seems to be a motor having two independent armatures in a single magnetic circuit. A vehicle with a motor on this plan has been designed by M. Henry Monnard, in France. The accompanying outline view of the motor shows the assembled rear axle. The two armatures are of the ring form and have their centres in line. The magnetic circuit consists of the two armatures and the two field pieces *e* and *f*. The centre line of the armatures coincides with the centre lines of the driving axles, and the armatures run on roller bearings on extensions of these axles. This form of motor may best be compared with a double motor equipment as usually employed. We have here two armatures, the same as with two motors. The field excitation requires about as much energy in the one case as in the other, and in point of efficiency the systems are thus about alike. Two motors, each of which has the same magnetic flux as this double armature motor, would have the same cross-section of iron in the field, but the total length of magnetic path in the field of the two motors is greater than the length of magnetic path in the field of the double armature motor. There is therefore a saving in weight in the double armature motor, and herein lies its advantage.

Another method of dispensing with the differential gear is to pro-

vide the vehicle with a motor of which both members are rotatory. In such machines armature and field revolve in opposite directions. This form of construction, although beset by a number of mechanical difficulties, has some very important advantages. The output of a motor is proportional to the relative speed between armature and field. The armature of such a motor is run at the highest speed permissible by the conditions of single or double reduction, as the case may be, the same as with ordinary motors. The relative angular speed of armature and field is double the absolute angular speed of the armature, and the output of such a motor is therefore double what it would be if only the armature were revolving. The starting torque impressed on the driving wheels is also double what it would be if only the armature were rotatory, which is easily seen from the following consideration: In an ordinary motor the torque of the armature reacts on the field frame, and through this on the motor supports. In a motor with armature and field revolving the total armature torque is impressed on one drive wheel, and the field torque which, according to the law of action and reaction, is equal to the armature torque, is impressed on the other drive wheel. This latter force, which in the ordinary motor appears as pressure against the motor supports, is here turned to useful account.

Among the mechanical difficulties or complications which are incidental to this form of construction, may be mentioned the extra pair of bearings on which the whole weight of the motor has to be supported, the rotating brushes and the contact rings and brushes necessary to bring the current to the armature and field terminals. The extra bearings involve extra losses and additional attention, and rotating brush holders an brushes have never been very satisfactory. Contact rings with brushes bearing thereon are used to convey the current to the field terminals and the brush holders. These rings are placed on the outside of the motor casing. A reversible series motor has four terminals, and four contact rings are therefore required. There is no convenient way of protecting these contacts against the splashing mud and water of the streets, and in times of inclement weather the insulation of these rings is liable to suffer. The motor casing, instead of being stationary, as usual, revolves, and it is not very desirable to have large revolving machine parts in sight on a motor vehicle.

In the United States the Eddy Electric Manufacturing Company and the United States Automobile Company have constructed motors of this type.

The Headland electric motor is a double motor on one shaft with both fields and both armatures revolving. The armature of one motor is mechanically connected with the field frame of the other. Eight contact rings are required with this type of motor to convey the current to the brushes and field terminals. This double motor is in operating qualities exactly equal to the single motor with rotating armature and field, and it is hard to see what has led the designer to adopt this complicated construction, unless it be the idea, expressed in the patent specification, that with this arrangement the rotating parts may be made to balance their centrifugal forces at all speeds. To secure vibrationless running, the separate revolving parts of this motor must be balanced before being assembled, which is all that it is necessary to do with any motor.

The field and armature of a motor of which both members are revolving, travel in opposite directions, and if one of the members is geared direct to one of the drive wheels by means of a spur gear and pinion, the other one has to be connected to its drive wheel by means of a spur gear, pinion and intermediate gear, or an internal gear and pinion to secure rotation in the right direction.

Another innovation in the automobile line is the hub motor. Both steam automobiles and electric automobiles have been constructed in which the motors are placed inside of enlarged wheel hubs. In the electric hub motor the motor field forms part of the hub casing and turns with the wheel. The armature turns free on the vehicle axle. To the hub casing is fastened an internal gear and to the armature spider a pinion. These two are connected by intermediate gear running on a stud which is held by an arm secured to the stationary axle. Here, as in the motors mentioned just above, both field and armature revolve, and the current has to be led to the brushes and field connections through sliding contacts. It is claimed for this construction that it takes all stress from the running gear, secures a good mesh of the gears and permits a thoroughly dust and moisture proof enclosing of the motors and gearing. For large omnibuses and vehicles of that kind all four wheels can be provided with motors, and thus the full weight of the vehicle be taken advantage of for securing adhesion.

The Facilities Afforded by the U. S. Office of Standard Weights and Measures for the Verification of Electrical Standards and Electrical Measuring Apparatus.

BY DR. FRANK A. WOLFF, JR.

THE need of adequate facilities for the official verification of standards and measuring apparatus of all kinds has long been recognized by American physicists. The U. S. Office of Weights and Measures, at Washington, D. C., has, with its small force, modest equipment and insufficient appropriations, endeavored to meet any demands imposed upon it within the limits thus set. The object of this article is to describe what has thus far been accomplished along electrical lines, and in this connection a brief history of the units of reference may not be considered out of place.

The origin of standards of quantity and value dates back as far as the earliest historical records. The transition from the crude measures of antiquity to the systems meeting present requirements has, however, been exceedingly slow, although the growth of commercial intercourse gradually led to the introduction of more precise standards. The requirements of accuracy were nevertheless quite modest until physics began to emerge from its qualitative stage to assume the dignity of an exact science.

The number and complexity of physical quantities at first led to the adoption of more or less arbitrary standards of reference, often based on the physical properties of some definite substance, e. g., the calorie; and as long as the relations between physical quantities remained obscure, such relative standards sufficed. With the development of the science came the recognition of the desirability of a consistent system of units, which was strongly brought to the front when it became necessary to measure magnetic quantities.

The happy solution of this problem suggested by Gauss and extended to the measurement of electrical and electromagnetic quantities by Weber, constituted a great advance in the science of metrology, the units being defined in terms of the mechanical actions to which they give rise. Since all mechanical units can be expressed in terms of three independent fundamental units, such as those of length, mass and time, the magnetic and electrical units of Gauss and Weber are thus expressible in terms of the same fundamental units, and are therefore entirely independent of the physical properties of arbitrarily chosen substances. Hence they are called absolute units, their magnitudes depending solely on the choice of the fundamental units.

The units of length and mass selected were usually multiples or submultiples of the corresponding metric units, the metric system being the only one meeting the highest scientific and practical requirements and being already in extensive use. While at first uniformity in the selection of the magnitudes of the fundamental units was lacking, the centimeter, gram and second have now been universally adopted, the derived units being known as c. g. s. units.

Practical measurements of electrical resistance were, however, first referred to a variety of arbitrary standards, e. g., the resistance of a given length of copper or iron wire of given diameter, and so long as electrical measurements were confined to the laboratory, the length referred to was usually a few feet, but with the practical applications of electricity to telegraphy and submarine signaling, this length became inconveniently small and was therefore replaced by fathoms, miles, etc. Fortunately none of these units ever gained general acceptance. In 1848 Jacobi pointed out that it would be far preferable to adopt as a universal standard the resistance of a certain piece of wire, copies having the same resistance being easily constructed. Jacobi carried this suggestion into practice by sending a piece of copper wire, since known as "Jacobi's Etalon," to various physicists for that purpose. In 1860 Werner von Siemens proposed as a standard of resistance the resistance, at 0° C., of a column of mercury, 1 sq. mm. in cross-section and 100 cm. in length. In 1861 a committee, composed of the most eminent English physicists, was appointed by the British Association to consider the question of standards of electrical resistance. Correspondence was opened with the leading foreign physicists, and various special investigations of the problems with which the committee was confronted were undertaken by its members.

The first question settled was that the unit of resistance should be defined as a multiple by an integral power of 10 of the unit of Weber's absolute system, and that the unit chosen should be of a

convenient magnitude. Accordingly, a unit equivalent to 10^9 c. g. s. units, was adopted. This definition fixed the unit, but the evaluation of a resistance in absolute measure requires the construction of especially designed apparatus, having usually a limited range of usefulness; the determination of instrumental constants, most frequently involving tedious mathematical approximations, and in addition the observations have to be made with the greatest precision. On the other hand, relative measurements require simpler apparatus and less skill in manipulation, besides being, in most cases, far more accurate than absolute measurements. The construction of material standards adjusted to the specified resistance, determined once for all by a series of absolute measurements, was therefore decided upon.

Investigations were made to determine whether the absolute unit of resistance could be accurately defined in terms of the resistance of a definite portion of a definite substance. Pure metals in the solid and liquid state and alloys were studied with this end in view. On account of the excessive influence on the resistance produced by small quantities of impurities in metals and by small variations in the composition of alloys and on account of the additional difficulty of procuring chemically pure materials, the choice was greatly limited. Moreover, solids had to be rejected on account of the marked effect of physical changes produced by drawing, bending, annealing, etc.

Mercury, already recommended by Siemens, was therefore the only material to be further considered. Even this material was rejected, owing to large differences found to exist between coils, supposedly adjusted to agree with different German mercury standards, and the mercury standards constructed by members of the committee.

Having abandoned the above propositions, the alternative remained of constructing material standards adjusted with reference to the absolute unit. A number of new alloys, in addition to many already in use, were made and investigated. An alloy of 2 parts by weight of silver to 1 part by weight of platinum was finally selected as best meeting all requirements. A special form of resistance standard was also adopted.

In 1863 and 1864 the values of certain coils were determined in absolute units by one of the methods proposed by Weber and from these measurements the B. A. unit was derived. A number of copies were issued gratis by the association, and in addition arrangements were made to furnish others at a moderate price. The B. A. unit soon gained universal acceptance in the English speaking countries, while the Siemens unit still retained its supremacy on the continent.

In 1878 it was shown by Prof. Rowland that the B. A. unit differed from its assumed value by more than 1 per cent., and soon after this difference was substantiated by a number of other investigators.

In 1881 a call was issued, in connection with the first Paris electrical exhibition, for an international electrical congress for the purpose of adopting definitions of the electrical units to serve as a basis for legislative enactments. Numerous mercury standards had in the meantime been constructed and had been found to agree most satisfactorily with one another; moreover, the results of a considerable proportion of the absolute determinations made had been referred, directly or indirectly, to the Siemens unit. In view of this, the Paris congress passed a resolution recommending that all absolute determinations in the future be expressed as the resistance of a column of mercury of stated length, 1 mm^2 in cross-section at the temperature of melting ice, and that the c. g. s. electromagnetic system of units be adopted. The desirability of making new determinations of the ohm was urged.

Three years later the congress reassembled at Paris and adopted 106 cm. as the length of the specified column of mercury, individual results still differing by as much as + .5 per cent. The unit of resistance thus defined was called the legal ohm, but while it was never legalized anywhere, it nevertheless came into extensive use, especially in England and in America.

Absolute methods were gradually improved, sources of error were pointed out and eliminated as far as possible, and accordingly the results of absolute determinations, made by the most radically different methods, became more concordant.

The International Electrical Congress which met in Chicago in 1893, through its Chamber of Delegates, officially representing all the leading governments, therefore adopted as the unit of resistance the mean of all the best determinations, the resistance at 0° C. of a column of mercury 106.3 cm. in length and of uniform cross-section having a mass of 14.4521 grammes (equivalent to a cross-section of 1 mm^2 the density of mercury being assumed to be 13.5956). The unit of resistance and the other electrical units defined by the International Congress were legalized in the United States by act of Congress in 1894, and have also been legalized in the other countries represented.

It was generally supposed that the various governments would sooner or later take up the construction of mercury standards as called for in the definition, since each had already been provided by the International Bureau of Weights and Measures with the fundamental standards of mass and length.

The Imperial Physico-Technical Reichsanstalt in Berlin had already begun this task with its characteristic thoroughness. Two one-ohm mercurial standards were constructed, and later a third, together with a one-half and two-ohm tube. Widely different cross-sections were purposely selected to avoid possible sources of error. The calibration and intercomparison of these standards leaves almost nothing to be desired, measurements made by two different methods both yielding the same results within the limits of experimental error.

Twelve mercury copies were also constructed; these, together with seven working standards of manganin wire, periodically referred to the primary standards, complete the list.

In England, on the other hand, the B. A. coils have still been retained as primary standards. The legal ohm was defined in that country by the relation, one Siemens unit = .9540 B. A. units, and later the international ohm was defined by the relation, one Siemens unit = .95341 B. A. units indicating a change in the coils themselves, or in their assumed relation to the Siemens unit, or in both.

Matters have been still further complicated in England by the legalization of the resistance of a coil marked "Board of Trade Standard Verified 1894," and adjusted with reference to the Cambridge Standards, as the unit of resistance.

A still more radical suggestion was made in that country several years ago by Prof. A. Viriamu Jones and Prof. W. E. Ayrton, that each government adopt a Lorenz apparatus from which to derive by absolute measurements the unit of resistance. The practical substitution of an absolute method with its disadvantages, as pointed out above, for a purely relative one seems to be taking a step, or, indeed, several steps, backward, but may be taken as indicating the lack of confidence in the permanency of the B. A. coils.

After the legalization of the international electrical units, it became the imperative duty of our government to provide facilities for the official verification of electrical standards and electrical measuring apparatus, especially in view of the continually increasing importance of the applications of electrical energy to the industrial arts. This function obviously devolved upon the Office of Standard Weights and Measures, already equipped for the verification of standards of length, mass, capacity, etc.

Owing, however, to the limited force and to the still more limited appropriations available for the purchase of apparatus, practically nothing could be done until July 1, 1897, when the appointment of a verifier was authorized, but unfortunately progress has frequently been interrupted for long periods by the pressure of routine work.

It was determined from the outset that it should be the aim of the office to provide facilities for measurements to any degree of accuracy likely to be set even by the most exacting demands of modern science. The first steps taken by the office consisted in working out a general plan and providing the most needed apparatus and facilities.

STANDARDS OF RESISTANCE.

To avoid the delay which would naturally arise from the construction of primary mercury standards, it was decided to refer all measurements of electrical resistance to the mean value of a number of wire coils known in terms of the best existing mercury standards. The general excellence of coils of the Reichsanstalt type, the extremely small temperature coefficients and thermoelectromotive power with respect to copper of manganin, and the permanency of coils of that material as shown by long continued observations at the Reichsanstalt, decided in favor of standards of the above description.

Four unit coils were purchased and were standardized at the Reichsanstalt, where they were kept under observation for about one month, during which period they decreased in value by about

.0015 per cent. This, according to the maker, is the normal behavior of the material, which undergoes after the artificial aging a small decrease in resistance followed by a slow increase. In addition to these coils the office possesses two other coils of the same type purchased several years ago. Periodic intercomparisons between the old coils and the new ones will be made so that any relative changes will become manifest, the two hardly having the same rate of change. Two new manganin coils have been ordered and are also to be referred to the German standards. On their receipt they will furnish us positive evidence in regard to any changes which may have taken place in the preliminary standards adopted. The approximate corrections at any time can then be determined by simple interpolation.

To fix this standard, the construction of a number of mercury copies will also be taken up. The construction of primary mercury standards, which is of fundamental importance, not only from a scientific standpoint, but also on account of the legal questions which will surely arise, will be undertaken as soon as time permits. The office has acquired, in addition to the unit coils, standards of the following denominations:

1	2	Ohms.
1	5	"
4	10	"
4	100	"
3	1,000	"
2	10,000	"
2	100,000	"
3	0.1	Ohm.
3	0.01	"
3	0.001	"
3	0.0001	"

The temperature coefficients of these coils were first carefully determined, then the coils of the same denomination were intercompared and the observations reduced to Differences at 20° C.

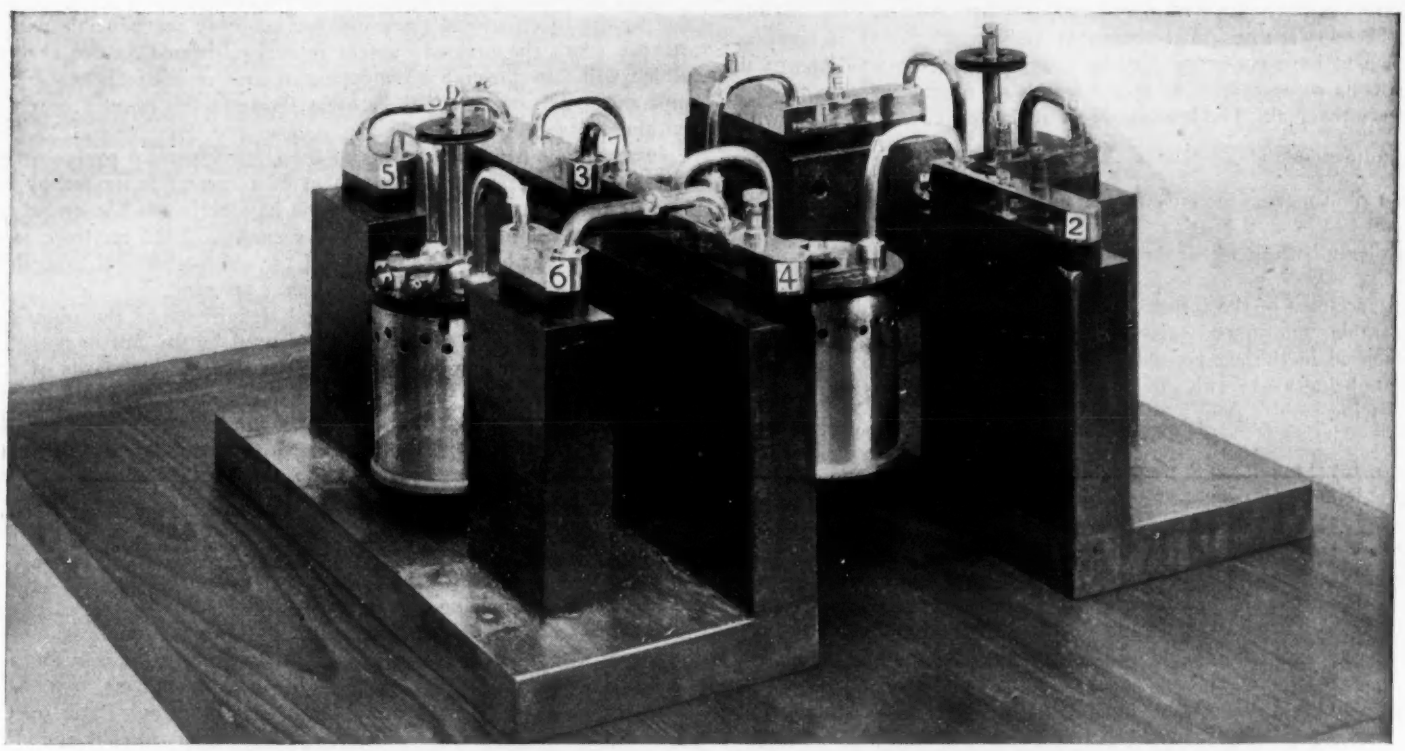
The next step consisted in determining the resistance of the multiples and sub-multiples in terms of the unit. Thus, two unit coils placed in series by means of a connecting link of known resistance were compared with the two-ohm coil. The five and ten-ohm coils were similarly evaluated in terms of the unit. From the known ratio of a 10-ohm coil to one of the units, the step can be made to the 100-ohm coils by means of a second 10-ohm coil, also known in terms of the unit. Similarly, the values of the coils of still higher value were determined and those of the sub-multiples of the unit, by a slightly modified method.

METHOD OF COMPARISON ADOPTED.

The practice in this country and in England has been overwhelmingly in favor of the Carey Foster method, but the construction of the Reichsanstalt standards, with their terminals 16 cm. apart, makes the use of the Carey Foster bridge almost out of the question. The design of a suitable bridge capable of comparing coils of this type with those having a different distance between the terminals, introduces still further complications. Moreover, in the Carey Foster method, additional resistances are introduced in the mercury cups of the commutator which are only eliminated in a perfect mechanical construction. Besides, the resistances connecting the coils to the commutator, unless equal, are *not* eliminated. While the Carey Foster method is at first glance superior in being a zero method, the Wheatstone-Kelvin bridge, more simple and far less expensive in construction, excels the former, especially where the intercomparison of low resistance standards is concerned, provided the coils to be compared are first made nearly equal by means of a shunt of known value applied to the greater. The value of the shunt need not even be known to a high degree of accuracy in case of fairly well adjusted coils.

The coils are connected to one another by copper forgings 1.5 cm. thick and 2 cm. wide, having therefore a resistance of about 0.6 microhm per cm. of length, and their terminals rest in mercury cups .75 cm. deep and 1.2 cm. in diameter. To permit the comparison of coils differing widely from the standards, provisions have been made to enable one of the coils compared to be placed in parallel with an accurately known coil by means of a second pair of mercury cups.

In the cut the forgings are numbered 1, 2, 3, 4, 5 and 6, and are insulated with ½-in. hard rubber. They rest loosely on wooden supports, those under 1 and 2 being fixed to a common base while the remainder of the supports are fixed to a second base, enabling the distance between the cups to be varied within wide limits. *A* and *B* represent the coils to be compared, and *C* is a ratio coil having an extra contact, *C'* dividing it into two nearly equal halves; 7, 8 and 9 are heavy copper links connecting the parts. Binding posts are provided at the points indicated.



VIEW OF APPARATUS USED IN MAKING COMPARISONS.

The coils *A* and *B* and the two halves of the ratio coil *C* form therefore the four arms of a Wheatstone bridge, the galvanometer (or battery) terminals being connected to *E* and *F*, the battery (or galvanometer) terminals to *C* and the middle of link 7. The galvanometer is permanently connected to the bridge to reduce the deflection due to thermoelectromotive forces in the bridge arms, and on closing the battery circuit a deflection is obtained depending on the difference between the ratios of the coils compared and the two halves

of the ratio coil. This deflection can be reduced to reasonable limits by shunting the larger coil. The value of the deflection is interpolated from the deflection produced by shunting one of the coils by a known resistance.

For example, in the intercomparison of unit coils, a shunt of 10,000 ohms produces a change in the ratio of the bridge arms of $\frac{100}{1{,}000{,}000}$. The arms of the bridge can easily be adjusted to within this limit, hence only small differences will have to be interpolated.

The sources of error characteristic of the direct deflection method are due to the following causes:

(1) Variation of e. m. f. of test battery.

(2) Variation of galvanometer sensibility, due either to the variation of proportionality between deflection and current, or to a change in the actual sensibility.

These only affect the deflection corresponding to the unbalanced *differences* in the ratios of the coils intercompared so that even if the errors in interpolation should be relatively large, the error in the ratio will be exceedingly small. With the ratios adjusted by means of shunts to within 100-millionths of equality an error of 1 per cent., five to ten times that actually existing, would produce an error of one part in 1,000,000 in the calculated ratio of A to B.

The Wheatstone-Kelvin bridge entirely eliminates the resistance of the parts connecting the lower mercury cups of A and B, by means of shunting a second ratio coil across the resistance to be eliminated, the battery or galvanometer contact being transferred to D'. The resistance between the upper mercury cups of A and B and the galvanometer binding posts are equal, and hence are eliminated as are also the correspondingly small resistances between these binding posts and the terminals of the ratio coil C, each half of which has a resistance of 10 ohms. The inequality of the two halves of this coil is eliminated by its reversal. The remaining sources of error are possible variable contact resistances in the mercury cups and possible differences in the insulation resistances between them. The bottoms of the cups are accurately surfaced and these sources of error are shown to have no importance by interchanging the positions of the two coils compared. Thermoelectromotive forces are eliminated by battery reversal. The heating effect of the test current was shown to be quite negligible, less than $\frac{1}{10{,}000{,}000}$ for a current of .03 ampere for 1 ohm manganin coils, since a current of 1 ampere through such a coil produces a heating of the coil above the temperature of the petroleum bath in which the comparisons are made, of approximately 1° C.

A specimen of the results which may be obtained under rather unfavorable conditions is given below. Four 1-ohm coils were intercompared in the six possible combinations, six additional measurements being made with the left and right coils interchanged with the following results:

		Observed differences.	Calculated differences.	Residuals. Obs.-Cal.
L 1402	1403 R	-3.8×10^{-6} ohm	-3.8	0.0
R 1402	1403 L	-3.9		-0.1
L 1402	1404 R	-4.6	-3.7	-0.9
R 1402	1404 L	-2.8		$+0.9$
L 1402	1405 R	-0.8	-0.8	0.0
R 1402	1405 L	-1.0		-0.2
L 1403	1404 R	$+0.2$	-0.2	$+0.4$
R 1403	1404 L	-0.6		-0.4
L 1403	1405 R	$+3.4$	$+3.0$	$+0.4$
R 1403	1405 L	$+2.5$		-0.5
L 1404	1405 R	$+3.4$	$+3.2$	$+0.2$
R 1404	1405 L	$+3.0$		-0.2

Since resistance comparisons can be made to such a very high order of accuracy to within $\frac{1}{500}$ per cent. at least, even in the case of properly designed .0001-ohm standards, all interested may assure themselves that every effort will be made by the office to provide itself with primary standards of reference meeting the highest scientific requirements.

STANDARDS OF ELECTROMOTIVE FORCE.

The unit of electromotive force, the volt, is legally defined as $\frac{1000}{1434}$ of the electromotive force of a Clark standard cell at 15° C. The official standards of electromotive force of a government should obviously be, as far as possible, independent of any error due to impurities of the chemicals used. A large number of cells were set up with the purest commercially obtainable materials, from a number of independent sources. The work of purifying these materials by special methods was begun. Cells have also been set up with some of the purified materials, though much still remains to be done.

The intercomparisons so far made indicate a most satisfactory agreement of all the cells on hand, well within ± .005 per cent. The mean electromotive force of the three dozen or more cells furnishes therefore a standard of reference which may be relied on within this limit. In addition to the Clark cells, a number of cadmium cells, having considerable advantages over Clark cells, have been set up, but owing to lack of time no comparisons have as yet been made. New cells of both types are to be added from time to time, and intercompared with the old ones to determine whether any observable changes have taken place.

The relation which the e. m. f. of the Clark cell bears to that of the cadmium cell will also be periodically determined, furnishing an additional check on the constancy of the standards of both types.

With an accurately calibrated potentiometer, and reliable standards of electromotive force the Office is thus prepared to undertake the verification of direct-current voltmeters and milli-voltmeters.

MEASUREMENT OF ELECTRIC CURRENTS.

A grave mistake was made by the International Congress in concretely defining all three of the principal electrical units, the ohm, volt and ampere, which are necessarily connected by the fixed relation $C = \frac{E}{R}$. Hence only two of the definitions are independent, the chances being infinitesimal that the three definitions satisfy the relation between them on account of the relatively large errors in the absolute determinations on which they are based. Indeed, it already seems that the volt, as defined in terms of the Clark cell is in error by almost .1 per cent.

Since the standards of resistance and electromotive force, as specified by the International Congress, are certainly reproducible within .01 per cent., the unit of current intensity, defined as the current which will flow through a conductor of unit resistance, there being unit difference of potential between its terminals, would be fixed within the same limits of error.

Instead, it is defined in terms of the electrochemical equivalent of silver. The voltametric measurement of a current is limited by the size of the apparatus available, and is besides impossible under ordinary circumstances with the above accuracy. Lord Rayleigh is of the opinion that his determination of the electrochemical equivalent of silver may be in error by as much as .1 per cent.

Retaining for the present the legal definitions of the ohm and volt, currents may be consistently measured by the fall in potential or potentiometer method, in terms of the specified standards of reference.

It is proposed to base all direct-current measurements on these principles. With suitable low resistance standards for the measurement of heavy currents and with the set of Clark cells already on hand, the Office is prepared to undertake the verification of direct-current ammeters within the limits practically set by the current generating apparatus on hand.

To summarize, the Office is therefore practically equipped for the verification of following classes of apparatus, viz.:

Resistance Standards.—Coils of the following denominations: 1, 2, 5, 10, 100, 1000, 10,000 ohms. *Low resistance standards* for current measurements of the following denominations: 0.1, 0.01, 0.001 and 0.0001 ohms. Resistance boxes. Potentiometers. Ratio coils.

Standards of Electromotive Force.—Clark standard cells and other standard cells.

Direct-Current Measuring Apparatus.—Milli-voltmeters and voltmeters up to 150 volts. Ammeters up to 50 amperes.

For the verification of direct-current measuring apparatus of even moderate range, the present facilities of the Office are entirely inadequate. Although provision must also be made for the calibration of wattmeters and energy meters, nowadays potential differences up to 20,000 volts and currents of 20,000 amperes are met with in actual practice.

The verification of alternating-current measuring apparatus requires further facilities, and in view of the ever increasing importance of alternating-current systems such facilities should be provided without delay. The verification of condensers and self-induction standards also merits attention.

Another question, practically related to electrical measurements, is

the photometry of arc and incandescent lamps. Preliminary steps have already been taken by the American Institute of Electrical Engineers, looking forward to the co-operation of the Office in the official verification of incandescent lamps as secondary photometric standards to enable even the moderate consumer to procure reliable standards at a reasonable rate.

The measurement of high and low temperatures will also be taken up, a knowledge of the exact thermal conditions under which certain industrial operations are conducted being of the utmost practical consequence.

There are two most reliable electrical methods based respectively on the variations of electrical resistance and of thermoelectromotive force with the temperature. Hence, with standards of electromotive force and resistance available, this subject is brought within easy reach.

No claim of originality is made in what has been accomplished. The magnificent work of the Physico-technical Reichsanstalt of Berlin, with its staff of scientific and technical assistants and in its almost unlimited resources, has been of the greatest help. It has set such a high standard of excellence that it will require years for similar bureaus, which will surely be organized by other governments, to attain.

Municipal Wiring a Failure in Boston.

BY ALTON D. ADAMS.

THOSE who believe in municipal and government ownership and control of most productive agencies may find some pertinent facts in the report just made by Mr. William Brophy, chief electrician of the Boston wire department, to Mayor Hart, on the electrical construction division of the public buildings department. Several years ago Mayor Quincy inaugurated the electrical construction division along with the city printing plant, to protect the city treasury from the extortions of private dealers and contractors. So well has the plan succeeded in the electrical construction division that the city has paid from two to three times as much for a large amount of work as private contractors wished to charge, and the division is now to be closed out as soon as possible. The great difference between the cost of work done by the city force and the face of the tenders for the same by private concerns seems to have been largely due to the class of labor employed. This point is put with no lack of clearness in Mr. Brophy's own words. He says: "A glance at the payrolls shows that nearly 60 per cent. of the men whose names they contain were appointed at the request of certain prominent gentlemen, who, to say the least, are not the best judges of the necessary qualifications of the employees of this department. Electrical contractors employ only a sufficient number of men to meet the requirements of their business. Not so with the head of this department, for when, in his judgment, the force should be reduced, owing to lack of business, he meets with a most decided opposition from the friends of the men whose services sound business principles prompt him to dispense with. In nine cases out of ten the men selected for dismissal, because their services are not required, owe their appointment to some active politician, high in the councils of his party, who sees to it that his friends are reinstated, regardless of the city's interest or the condition of its treasury. As a result of this unwarrantable interference men are kept on the payroll whose services are not needed, and others who never should have been employed. Discipline, which is so necessary for the success of any establishment, cannot be maintained in this department so long as a large percentage of its employees can retain their position, not through any effort of their own, but owing to party exigencies." It is charged in the report that unnecessary work has been undertaken by the electrical construction division in order to keep a large number of men employed. One instance, where it was sought to undertake a very large and entirely unnecessary piece of work, is said to be that of the new court house, where the wiring was reported to endanger the building, and a request was sent to the judges to have it rewired by the electrical construction division. On examination by Mr. Brophy the wiring at the court house was found in satisfactory condition.

The report goes on to give items of equipment and cost for a large number of plants installed by the electrical construction division. Three of the East Boston ferryboats have been equipped with electric light plants at a total cost of $10,200 by the electric construction division. A bid for the complete electrical equipment on these three boats and one other was received from the General Electric Company, the price being $6800. Per lamp installed the General Electric price was $23.61, while the cost to the city through the electric construction division was $47.22 per lamp. On another boat the Westinghouse Company bid the sum of $3900 for a complete plant, and the electrical construction division did the job at a cost of $5800 to the city. Figures for land work done by the division seem about as high in proportion as do those on the water. The Ann White Vose Building at the city hospital was wired at a total cost of $4,754.56, or $12.96 per outlet, the estimated cost being $4.50 per outlet. The English High School was wired for a total cost of $3,797.40, or $5.55 per lamp, the estimated fair cost being $2.25 per lamp. In the Irvington Street armory 943 incandescent and 24 arc lamps were installed at a cost of $6,683.47, the fair estimated cost being $2,571.75, or 38 per cent. of the actual sum paid out. All of the plants cited in the report of Mr. Brophy show about the above proportions between actual and the fair estimated cost.

On all of the work reported the labor item shows much more than its usual per cent. of the total cost for complete equipments. The percentage of labor to the total cost varies from 47 to 62 per cent., being in most instances nearer the higher figure. In closing Mr. Brophy says: "I think it best for you to discontinue the electrical construction division, that has proved a rest for the weary, a spawning bed for embryo statesmen, and has accomplished so little of the real work for which it was organized, viz., guarding the city treasury against the rapacity of electrical contractors and dealers."

The First Independent Telephone Exchange in New York City.

ALTHOUGH the independent telephone movement has been very marked in various parts of the country, New York City has hitherto escaped from sharing actively in it. Just why such should be the case, it is hard to explain, for there has been talk enough on the subject; the daily press has lent its support to the agitation and of proposed opposition companies there have been at least half a dozen. It is, in short, not a little singular that only now after years of practical independent telephony

FIG. I.—KNICKERBOCKER CENTRAL TELEPHONE EXCHANGE, NEW YORK.

throughout the country, we are able to call attention to two actual independent exchanges in New York City. Possibly the predecessors of the Knickerbocker Telephone & Telegraph Company lacked the capital of that concern; but when one recalls their long lists of influential names of men of wealth it would certainly seem that they lacked the nerve.

Be that as it may, the Knickerbocker company, with very little noise or fuss, has gone right ahead with its plans, and now has actually begun work in the two offices of which views are here given. In fact, before this article appears, President W. H. Eckert will have removed the executive offices of the company to the huge Astor Building at the corner of Elm and Broome streets, of which a lease has been taken for twenty years. The building has seven stories each with 13,000 square feet of floor space. The seventh floor has been made into a suite of executive offices, with elec-

trician's laboratory, store room, etc. The sixth floor will be the main exchange in which a board will be installed for 5000 subscribers, but not more. Mr. Eckert has strong objections to very large boards and prefers the distribution of subscribers into a number of smaller exchanges. He has recently visited all the large independent exchanges throughout the country, accompanied by Mr. W. M. Miner, electrician of the company, with a view to the adoption of the best system and the best features. The building has a spacious "L" wing, enclosing an airy court, in which on this floor the cross connection board will be placed. On the same floor also, retiring rooms for the operators, lunch room, sick bay, etc., are being fitted up. The wires to and from this floor will run in a large brick cable shaft at the rear of the building. The board itself will be parallel with Elm Street, and have its back therefore to the whole range of windows besides being well lighted in front. The fifth floor is reserved for the use of the Telephone, Telegraph & Cable Company of America, which recently effected such a remarkable coup in the purchase of the whole Erie Bell system, and which has thus sprung at once into leadership of independent telephony. All these upper floors are reached by elevator in front and two elevators in the rear, besides stairways.

All connections will of course reach the building through subways, and the basement of the building would seem to have been specially designed with an eye to its use for cable runways. It is

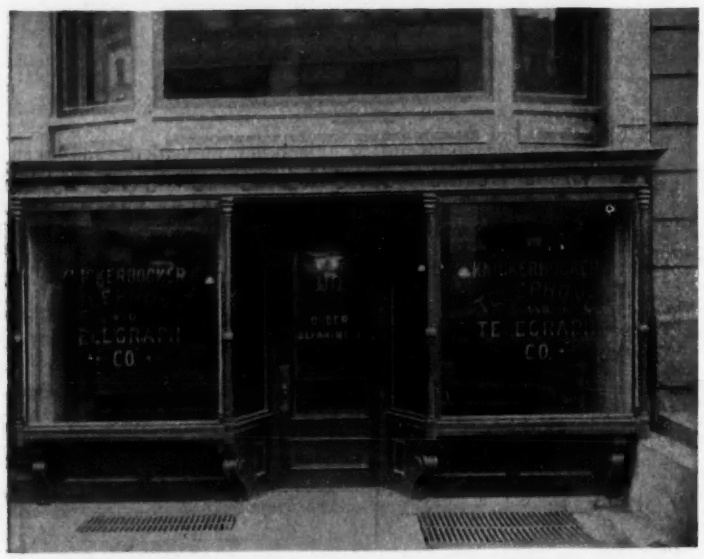


FIG. 2.—KNICKERBOCKER BRANCH EXCHANGE.

not only unusually large, but is lofty and very light, and "as dry as a bone." It contains a steam and electric plant, which is to be very much enlarged, while the elevators are also to be operated electrically.

The other temporary exchange of the Knickerbocker company has been opened at 115 East Twenty-third Street, about three miles away; and the company has already laid cable between the two points. Of course it will take some months before the regular large boards for these exchanges can be built and put in operation, but in the meantime the company is operating an excellent smaller equipment furnished by the Phoenix Telephone Company of this city. All told, there have been laid about seven and a half miles of cable on Broadway, Fourth and Sixth avenues, Twenty-third Street and other thoroughfares as far up as Twenty-ninth Street. For the Borough of the Bronx, the company has already bought a number of poles for aerial lines. It has some 60 canvassers out securing subscribers, and President Eckert reports himself as more than pleased with the sure and steady progress that is being made in all the departments of the work.

Automobiles for Africa.

Fifty-five automobiles have been built in Paris for African service. They will be used in the Congo Free State to transport freight and passengers between the present terminus of a railroad at Badunbe to the upper and lower Niger. As the railroad construction advances, the route will be shortened, and when the roads are completed the wagons will be used elsewhere.

Arguments for and Against Automatic Telephony.

A very interesting argument has developed in New England, as to the value of automatic telephone systems, in connection with the application for a franchise in Springfield, Mass., by the Hampden Automatic Telephone Company. At a recent hearing before the local authorities Mr. I. H. Farnham, the well-known Bell telephone expert, said he had examined the automatic system in operation very carefully, had studied the 300 patents concerned and he was ready to say that the system is not practical. In personal tests which he made he found that of 100 calls, at least half were failures, there being no response or a failure to get the right party. In Aiken, S. C., the failures are even greater in proportion. In Augusta, Ga., he found many of the stations out of order. The dial refused to work and other objections were noted. Another objection was that a person standing on a damp floor would receive an electrical shock from the dial. Another point urged against the telephone is that it is provided with no protector to keep out the electric currents which might result from a chance contact with electric light wires or from lightning. In Aiken, S. C., and in Amsterdam, N. Y., he found that fires had resulted in the central offices from the absence of such protectors.

The automatic people claim that their system gives quicker, more accurate, secret and cheaper service. Mr. Farnham said that he had found that the average time required to make a connection with the automatic telephone is 11 seconds, while the Bell system is much less, being about four seconds in Springfield. He stated that the ordinary subscriber could only with difficulty use the automatic telephone in the dark, although an expert might do so. Going to the second point, he said that the subscriber is more likely to make mistakes in the automatic than in the Bell system, since the apparatus is more complicated. The service, therefore, he said, is not more accurate, but less so, and it takes longer to correct a mistake without a central operator than with one. As to secrecy, he said that in any system it is practically impossible, and with the automatic system it is improbable. He said that in the ordinary multiple board exchange each operator makes on an average 200 connections an hour, which give her no time to listen to the conversation on the wire, while under the automatic system the expert at the central office would have all the leisure he wanted to hear what was going on between subscribers. On the last point Mr. Farnham said that the automatic system cost much more to construct than the regular switchboard system, since the apparatus is more expensive and complicated. In addition to this, more expert knowledge is required to run the system properly. The increased cost in installing the plant, in hiring the experts and that due to depreciation of the plant more than counterbalances the cost of maintaining the force of central operators. Mr. Farnham dwelt upon the point that the central office of a modern telephone company is fast becoming a bureau of information for the enlightenment of its subscribers. This led to a discussion of the possible abuses which, it was alleged, the secrecy of the automatic system has led to in certain cases. The fire department have been called out on false alarms over the automatic telephone. The police have been sent on fruitless errands, and newspapers misled by people, who maliciously used the automatic telephone, knowing that there was no way in which to trace out their identity. In one place, he said, the fire department has a standing rule not to answer any calls which come over the automatic telephone. In most places where there are rival companies about one-half the users of each telephone are subscribers to the other.

Mr. S. L. Powers, attorney for the New England (Bell) Telephone & Telegraph Company, said that the automatic system was a fascinating one, but its strongest objection was that only 20 companies had bought it, and that the largest exchange has only 500 subscribers. On the question of royalties, he said that the New England last year paid $3.63 an instrument, while the Automatic Company, by their own statement, would pay $5. He said that the New England Telephone Company pays a 6 per cent. dividend, and its stock is quoted on the market at 140, and that he believed that if the company could reduce rates in Springfield, and at the same time insure its stockholders 6 per cent., it should do so. The company has in the past made an average yearly reduction of $4 a telephone, and the officers of the company are pledged to reduce rates as fast as possible.

Mr. E. A. Keith, of Chicago, an electrical expert, was called by Mr. C. L. Gardner, the attorney for the Automatic Company. Mr. Keith's testimony differed materially from that offered by Mr. Farn-

ham, and in certain points appeared to be exactly contradictory. He said that the time required for a call by one accustomed was about one second for each decimal on the dial, which would make three seconds the maximum time required to call any subscriber in an exchange of 999 telephones or less. He said that the work being carried on in Chicago was more extensive than that reported by Mr. Farnham, and that the Chicago scheme was not on paper alone, but was actually being worked out. He said that all the automatic exchanges now in operation have been installed within three years, and that the system, although first talked of in 1891, was not perfected until within that period. The system, he said, will admit of party lines, but the local company does not propose to put them in because of their inferiority. On another point Mr. Keith said that every Bell company has an expert at the central office whose opportunity to overhear conversation on the wires is as great as any that could be hired by the automatic company, and that in addition to him, each Bell company exchange has a number of operators. He said there is very little chance of the wires getting crossed, and that secret service is practically assured where metallic circuits are given. He said that the automatic system is even yet practically unknown to the public—and that either system can be abused, the Bell almost as readily as the automatic.

Apparatus for Finsen Phototherapy.

By S. D. BENOLIEL.

In the article on Finsen's system of phototherapy which appeared in a preceding issue, a cut was omitted showing the arrangement of electrical apparatus as employed by Dr. George G. Hopkins, of Brooklyn. The accompanying Fig. 1 shows the type of arc lamp employed, and the lamp support is shown in Fig. 2. The suspension fixture consists of three ornamental vertical arms secured by bolts to the ceiling. Within the arms at the upper ends is a disk for bracing the arms and also for supporting the arc lamp in a manner which

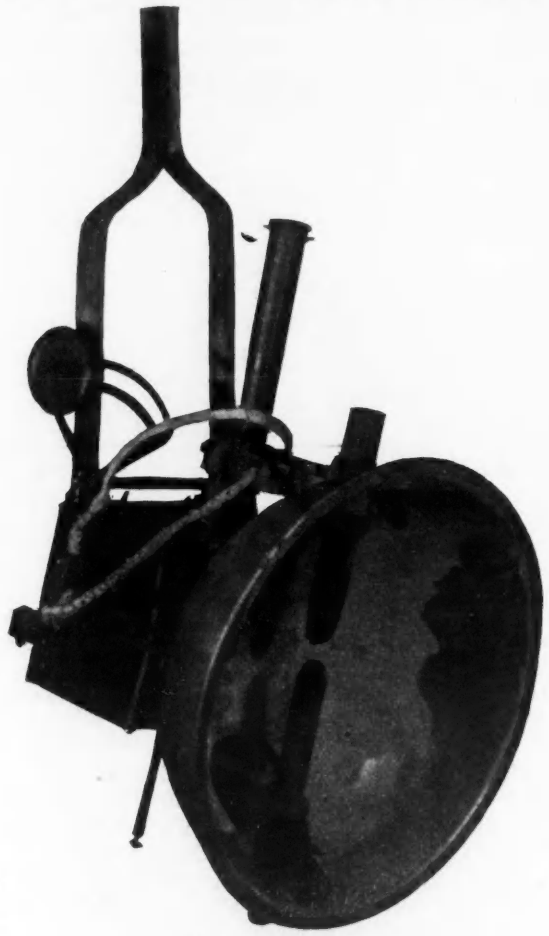


FIG. 1.—ARC LAMP.

will be explained later. At the lower ends of the arms is a ring which supports a metal cylinder (5), the object of which is to mask the arc from the eyes of the patients. Below the arc is a pan (8) to catch any drippings from the arc carbons.

The tube (2) (not very plainly shown) is secured to the disk at the ceiling, and in this slides a rod terminating in a Y to which the arc lamp is secured. This rod may be slid up or down or turned in the tube, a screw clamp securing it when the lamp is properly adjusted in position. The lamp is suspended between the prongs of the Y so that it may be tilted and clamped in any desired position. As a result of this method of suspension, the lamp may be adjusted upward and downward, in azimuth or tilted, thus enabling it to be placed in any position necessary to properly focus the light.

The light is focused from a long telescopic tube (7) which is placed at such an angle to the arc as to utilize the rays of maximum intensity. The lower carbon of the lamp is solid and seven-eighths of an inch in diameter; the upper carbon is cored and one inch in diameter. It has been found that cored carbons cannot be used for the lower carbon, as they make the light unsteady.

Behind the arc is a small reflector which throws the light into the telescopic tube (7). This latter consists of two tubes sliding into each other, the one near the light being 25 inches long and 2½ inches in diameter and the other 24 inches long and 1¾ inches in diameter. This sliding arrangement enables the operator to place the patient conveniently during the application of the rays. In the end of the sliding tube of the telescope are fitted two plano-convex lenses of quartz 2½ inches in diameter with the plane sides touching, and giving a focal length of about 4¾ inches. Quartz is used instead of glass, since it allows the highly refrangible rays of light to pass

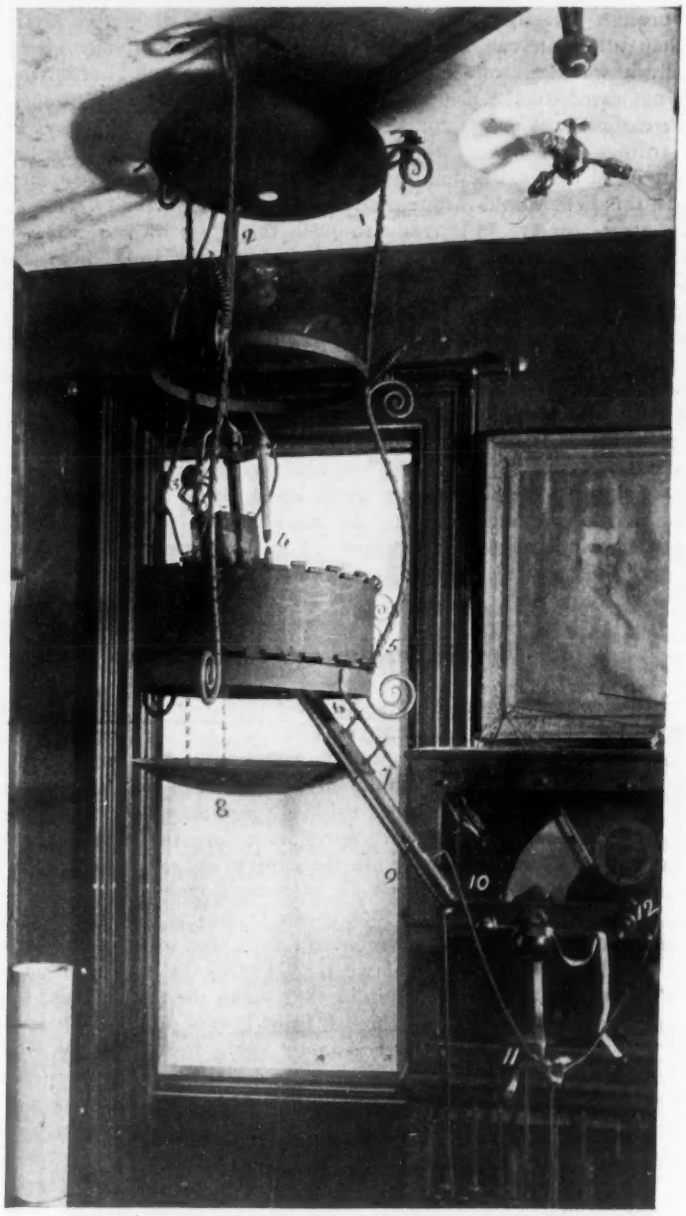


FIG. 2.—LAMP SUPPORT.

through more easily than glass. At the end of the lower tube (9) is a chamber 6½ inches long by 1¾ inches in diameter, the upper portion of which contains a quartz disk and the lower portion a quartz lens 1½ inches in diameter. This chamber is filled with distilled water, its object being to cool down the rays which pass

through it. It has been found that after a very short time the water becomes very hot, to prevent which the chamber is surrounded by a water jacket, through which water is kept constantly flowing.

The quartz lens has a focal length of 4 inches, so that all the germicidal rays are concentrated that distance from the end of the tube. At this distance a piece of apparatus is placed, which is interposed between the rays and the diseased portion of the skin. It consists of a brass ring in which is set a focus lens and a plate of quartz, through which water is kept flowing continually. This arrangement, which is called the skin lens, is attached to the patient by means of silk tapes. It is claimed that the rays in passing through the two water chambers are cooled and consequently do not exert any burning effect upon the skin.

Narrow Gauge Electric Railways.

The announcement was made last week of the formation of the Industrial Railway Company, with a capital stock of $100,000, to manufacture machinery of all kinds and build, equip and operate industrial and other railways. Among the incorporators are Mr. H. McL. Harding, formerly of the Sprague, Westinghouse and Walker companies, and Dr. S. S. Wheeler, the president of the Crocker-Wheeler Company, and the plans of such prominent men in the electrical field naturally arouse interest and curiosity. It appears that these authorities have satisfied themselves from a thorough investigation of the subject that the time has arrived when attention can be profitably paid to narrow gauge electric railway work, a branch of development that has been almost wholly neglected for the last ten years. Some of the first work done in the earlier days of his connection with the Sprague company, Mr. Harding says, was of the narrow gauge type, and he has been convinced ever since then that with perfected apparatus and methods, this field would in due time offer a large opportunity. He and his associates are now ready to push this class of work, leaving altogether aside the heavier work of street car lines, interurban roads, etc., and they are now ready to take contracts. The work divides up into several fields, such as light transportation of fruit, vegetables, produce, etc.; connecting links between railroads and hotels in place of the stage; the handling of tropical crops such as sugar cane, coffee, etc.; mining work, short lines in mills, factories, yards, etc. For all this class of work, electricity is peculiarly applicable on the score of convenience, cheap first cost, economy in operation, etc. Mr. Harding has assumed charge of all the commercial part of the company's work, while Dr. Wheeler is devoting his well-known electrical and mechanical skill to the production of the various apparatus required. For the present the headquarters of the company will be in the Commercial Cable Building, New York City.

The Manufacture of the Pacific Cable.

President Scrymser, of the Pacific Cable Company, appears to doubt the ability of this country to build and lay the proposed cable across the Pacific, on the ground, it would seem, that never having done such a thing, our manufacturers never can do it, regardless of their similar work in other fields. Speaking of the matter last week he said: "We in America never have done that work, and the plants, the capital, and above all, the experience, which are required for ocean cable making cannot be improvised under the touch of a government undertaking. A look at the history of cable making for ocean lines will show why we haven't done this work, and why we cannot do it offhand, even if we try. Practically all ocean cables, from the first transatlantic line in 1857 up to the present day, have been made in England, and English firms have a practical monopoly of the experience. The first Atlantic cable was made by Glass, Eliot & Co. The failure of this and the loss of the second resulted in the formation of a great company—the Telegraph Construction & Maintenance Company, backed by great capital, and this company made a success of the third cable, and gave impetus to further work of the sort. But the manufacture stayed in England. The necessary experience has been expensive, and England was the first to acquire it. Then, in 1870, when England paid $60,000,000 for the land-telegraph lines of the islands, that capital went at once into plants and ships for making and laying ocean cable. Thus, England has the lead. To make a cable in America we would have to have a big plant and a good many men of practical experience in such work.

"For this, a large investment, far into the millions, would be required, and if the cable when laid should fail in any way, its makers would suffer a dead loss of all their work and have to replace the cable at their own cost. Then there must be some ten ships of at least 4500 tons, specially constructed for the work. Each ship requires a full outfit of apparatus, for every branch of the work, and to be manned by men of experience. All this equipment is found only in England. Evidence of this appears in the course taken by Germany in the matter of the new German cable to New York via the Azores. Germany wanted a cable she could be sure of, and wanted it quickly—just the situation at present of the United States. She guarantees about 7 per cent. of the whole cost, and then the cable is made in England. That shows the German appreciation of this need of experience and great equipment."

New York Printing Exposition.

Preparations for the Mammoth Printing Exposition and Fair at the Grand Central Palace, New York City, are well under way. With over one-third of the available space already sold to manufacturers representing all branches of the printing and kindred trades, including an exhibit of a complete daily newspaper plant (typography, engraving, stereotyping and printing), and negotiations pending for other large exhibits, the management feel pleased with their work to date. The quality and variety of the exhibits are also mattters of gratification. Firms that are foremost in all the branches of the art are planning to show their wares, and it now looks as if it would be in reality what has been said of it, viz.: not only a comprehensive display, but a great trade sale as well. The management have undertaken to interest employing printers within a radius of 200 miles, and to that end have mapped out a system of correspondence and circularizing. Organizations connected with the trade will be invited to hold their meetings within the exposition building, and rooms will be provided for that purpose free of cost. We understand from Mr. Marcus Nathan, the general manager, that among the exhibits already arranged no fewer that twenty-one electric motors will be in operation.

CURRENT NEWS AND NOTES.

THE MORMON CHURCH'S TELEGRAPH SYSTEM SOLD.—The Deseret Telegraph Company, heretofore owned by the Mormon Church, has been sold to the Western Union Telegraph Company. The system extends throughout Utah and into Idaho and Nevada.

ELECTRIC BOATS ON THE CHICAGO DRAINAGE CANAL.—Francis Regnault, an electrician of East St. Louis, Ill., is in Chicago for the purpose of organizing the American Electric Caravel & Gondola Company. The promoter of the enterprise believes that if the right of way for a trolley line of the Chicago River and drainage canal can be secured, a line of electric boats over the course will be installed.

CUBAN CABLES.—Last week ex-Senator M. C. Butler made an argument before the Senate Committee on Relations with Cuba in support of the pending joint resolution to enable the Commercial Cable Company to extend its lines to Cuba. His point was that there was a mistake in the preamble of the royal decree, by which Spain was led to understand and believe that the United States Government had previously given its consent to the grant to continue "forty years" instead of "fourteen," as the record shows was the actual limit of the grant.

NATURAL VS. MECHANICAL DRAFT.—At a recent meeting of the American Society of Mechanical Engineers, Mr. Chas. T. Porter, in his discussion of Dr. Thurston's paper on "The Steam Engine in the Close of the Nineteenth Century," stated that it is a principle of "the new engineering" that "the boiler furnace shall be independent of natural draft, effectually consuming its smoke, and burning two or more times as much coal per square foot of grate as it could do under natural draft alone, and yet sending off the gases at a low temperature; the boiler being a steam generator, a superheater and a fuel economized combined." Some years ago the late J. C. Hoadley expressed the opinion that "there can be no doubt that the heat to be returned to the furnace would several times exceed that necessary to make the power required to drive an exhausting fan."

GOVERNMENT TELEPHONY.—The Boston Associated Board of Trade, the Massachusetts State Board of Trade, the Boston Chamber of Commerce and the Boston Fruit & Produce Exchange have taken action favoring state supervision of the telephone and telegraph service.

PRODUCTION OF LEAD PEROXIDE.—In a patent issued Feb. 27 to Herman Beckman, of Witten, Germany, a process is described for the production of peroxide on Planté storage battery plates. The plates to be peroxidized are introduced as a positive into a solution of free sulphurous acid and then subjected to the action of an electric current for about thirty hours, when the plate is ready to be placed for use in a storage battery.

CHICAGO ELECTRICAL ASSOCIATION.—At the February meeting of the Chicago Electrical Association Mr. Budd Frankenfeld read a paper entitled "Copper Economy of Transmission Lines," in which the subject was treated from the standpoints of inherent first cost and high-voltage limitation. Sections of the paper also treated of aluminum vs. copper conductors, self-induction, capacity and skin effect.

CARBON PRIMARY CELL.—In a patent issued Feb. 20 to Albert Pfennenberg, of Berlin, Germany, a voltaic cell is described, the essential feature of which consists of an inner carbon cylinder having a deep groove or channel cut in the part which dips into the exciting fluid. The zinc surrounds the carbon cylinder, and one end also bends into the above mentioned groove, thereby increasing the efficiency of the cell. By means of distance pieces the cylindrical portion of the zinc is kept from touching the carbon cylinder, and by similar means the end of the zinc which projects into the groove is kept centred.

ELECTROLYTIC LAMP.—A patent was issued Feb. 27 to Wilhelm Boehm, of Berlin, Germany, on a lamp of that type in which the incandescent body is not a conductor at the ordinary temperature. The incandescent body has the shape of an elongated cylinder and is secured vertically in the conducting circuit. At the base of the cylinder is a mantle made of material which will occlude gases, and below the latter is a gas jet. When the lamp is put in circuit, the gas jet is lighted, which heats the incandescent body to a temperature when it becomes a conductor. Several automatic means are described for shutting off the gas when the lamp is in working condition.

ELECTRIC TRACTION UNDER STEAM RAILWAY CONDITIONS.—At the February meeting of the American Institute of Electrical Engineers, Mr. Edward C. Boynton presented a paper with the above title, in which he considered the question of the substitution of electricity for steam as a motive power on large steam railway systems of the United States. The paper dealt rather with the details of equipment than with the discussion of the financial questions involved. The type of motor for different kinds of service was discussed, as was also the method of power transmission, the type of contact conductor, the insulation of the positive wire, the track bonding, car wiring, heating of cars and the lighting of stations and freight houses along the line.

THE SOUTHWESTERN GAS, ELECTRICAL AND STREET RAILWAY ASSOCIATION will hold its next annual convention in Waco, Tex., on April 18, 19 and 20. The following named papers will be presented at the meeting: "Electrolysis," by E. H. Jenkins, of San Antonio, Tex.; "Meters and Incandescent Lamps," by W. R. Ruthell, of Waco, Tex.; "Electricity vs. Gas for Lighting Purposes," by J. F. Cullinan, of Denison, Tex.; "Street Railways of Texas From an Historical Standpoint," by F. E. Scovill, of Austin, Tex.; "The Attitude of Municipal Corporations Towards the Public," by John G. Boyd, of Terrell, Tex.; "Operation and Maintenance of Street Railways," by H. F. MacGregor, of Houston, Tex. Papers on subjects yet to be selected will also be read by E. D. Dysterud, of Monterey, Mexico., and J. C. Lord, of Fort Worth, Tex.

ELECTROLYTIC TREATMENT OF ORES.—In a patent issued Feb. 27 to Ellis F. Frost an electrolytic method is described for treating chemicals and non-conducting ores, consisting in mechanically introducing the materials to be treated into an electric arc formed between a carbon electrode and an electrolyte. As described, the narrow extremity of a hopper or funnel dips into the electrolyte; the carbon conductor occupies a central position in the hopper, its end also dipping into the electrolyte. The space between the carbon and hopper is filled with the material to be treated, and when current is turned on a powerful arc is established between the carbon and the liquid, and acts upon the material surrounding it. One of the applications of the process is in the direct production of acetylene gas. A mixture in proper portions of lime and carbon is introduced into the hopper, and the carbide formed therefrom drops into the electrolyte and there forms acetylene gas.

CONTROLLER FOR ALTERNATING CURRENT CIRCUITS.—In a patent issued Feb. 27 to E. J. Berg a type of controller is described having for an object reduction of sparking when a closed alternating current circuit is opened. The alternating current circuit is provided with an inductance coil, which is so situated with respect to a controller cylinder that when the circuit is closed, a curved plate of metal on the cylinder is brought into close mutual inductive relation to the inductance coil. This plate of metal acts as a short-circuited secondary, and reduces the self-inductance of the inductance coil to insignificance, its presence thus not affecting the circuit when closed. When, however, the circuit is to be broken, the metal plates are first removed from proximity to the cores of the inductance coil, thus setting up a counter e. m. f. of self-induction, which cuts down the current to a minimum at the moment when the circuit is broken, and thereby reduces sparking to a minimum.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.—The 140th meeting of the Institute was held at 12 West Thirty-first Street, New York, on Wednesday, Feb. 28. A note on "A Faradmeter" was presented by Dr. M. I. Pupin, and the instrument described and explained by the author was exhibited by him. Messrs. Hering, Wolcott, Bradley and Reed took part in the discussion. A paper was presented by Edward C. Boynton, of New Haven, entitled "Notes on Electric Traction Under Steam Railway Conditions." The discussion was opened by Mr. F. J. Sprague and continued by Messrs. Hutchinson, Hanchett, Lamb, Ries, Pope, Holbrow, Mailloux, Atwood and Emerson. At the meeting of the Executive Committee in the afternoon the following associate members were elected: Howell Henry Barnes, general engineer, Mexican Electric Works, Mexico City; John Duncan Boyd, electrician, Yuba Electric Power Company, Marysville, Cal.; Clement W. Evans, electrical engineer, American Engineering Company, Mexico City; Lewis Warner Henry, engineering department, Mexican General Electric Company, Mexico City; A. M. Hunt, consulting engineer, San Francisco, Cal.; Wm. G. Lawrence, manager of Municipal Light & Power Department, Hudson, Mass.; J. L. McCreary, constructing engineer, District Railway Company, Mexico City; H. D. McVay, city electrician, Wichita, Kan.; Morris M. Neurath, consulting engineer, Chicago, Ill.; Frans Oscar Renstrom, superintendent, Regla Power Company, Pachuca, Mexico; Mariano L. Schiaffino, chief electrician, Campania de Luz Electrico, Guadalajara, Mexico; Walter Eugene Smith, electrician, United Electric Improvement Company, Philadelphia, Pa.; Geo. Lourie Wiley, manager, Standard Underground Cable Company, Arlington, N. J.; J. M. Zapata, constructing engineer, Mexican General Electric Company, Mexico City. Mr. Edward J. Willis, of Richmond, was transferred to membership. It was voted by the Executive Committee that the annual business meeting should be held in New York City on May 15, the date fixed by the constitution at which the ballots for new officers will be canvassed. On the afternoon of the following day, May 16, the general meeting for the reading and discussion of professional papers will opened at Philadelphia, continuing possibly for three days.

SLEET STORM IN CLEVELAND.—A sleet storm in Cleveland and vicinity last Thursday caused an immense damage to overhead wires. The Cleveland Telephone Company was the worst sufferer, losing fully 1000 poles in various parts of the city and throwing 4000 telephones out of service. The estimated loss by this company alone will reach $250,000. The Western Union Telegraph Company was also a heavy loser. For twenty-four hours the city was almost isolated from the balance of the country, the few messages that were sent out going by circuitous routes. Many of the large mains will have to be replaced, and this company's loss will reach $80,000. The Cuyahoga Telephone Company and the Postal Telegraph Company were heavy losers, but not to the extent of the other companies. All of the street railways in the city, both cable and electric, were obliged to suspend service, some of the lines not getting into operation for two days after the storm. As a precaution against accidents the elec-

tric illuminating companies were not allowed to turn on their current and for two nights the city was in total darkness. Despite this precaution accidents were numerous, several people being injured by live wires, while fully twenty horses were killed by stepping on wires. Both the fire alarm and the police patrol services of the city were completely crippled, but by good fortune serious fires were averted. All of the companies will lose thousands of dollars worth of wire and poles because of thieves, who had excellent opportunity to secure all they wanted in the darkness.

WIRELESS TELEGRAPHY.—A patent was issued Feb. 27 to A. F. Collins on what are stated to be improvements in wireless telegraphy. In proximity to the usual form of transmitter is placed an arrangement in appearance like a hollow cone pulley of a lathe; that is, in the form of a number of annular steps of different diameters. This is called a wave reflector, and is arranged with its hollow portion toward the spark gap. As illustrated, the transmitter is nevertheless provided with an aerial conductor. The coherer consists of a glass tube, into which are inserted two metallic plugs with their inner ends beveled to the form of a tapering pocket for the coherer powder. The bottom of the coherer is closed by a metallic strip of high electrical resistance, which also bridges the inner ends of the plugs. On top of the tube above the pocket is placed an electromagnet. The outer end of one of the plugs is connected with an aerial conductor and the other end to the earth. Another connection is made to each plug by the terminals of a local circuit, which contains the above-mentioned electromagnet, a battery and a second electromagnet as a relay. The specification states that when the etheric waves from the transmitter come in contact with the aerial conductor, and through it, attack the little particles in the coherer, their resistance is materially lessened, in this being considerably aided by the bridge between the connecting plates; this causes the magnet above the tube to attract the powder filling, which latter, by its own gravity, fall back to its original place. Why this latter effect should improve the coherer is not stated, nor is it explained why the so-called wave reflector should concentrate the waves produced by the transmitter and reflected them in parallel lines, as claimed.

TELEPHONE PATENTS.—Among the patents issued Feb. 27 were one each on a telephone transmitter, receiver, relay and microphone. The patent on the telephone transmitter was issued to A. K. Keller and relates to the type employing granular carbon, the object of the invention being to prevent packing of the carbon granules and insure continuous adjustment and sensitiveness. The containing shell is divided into two parts accurately centred with respect to each other, so that when fitted together their axes are coincident. A central chamber is formed in the body of the rear part in which are the electrodes. On the front part of the shell is secured the diaphragm, which carries a plunger electrode consisting of a spindle with a cup head holding a carbon button. In the chamber of the rear part of the cell the other electrode is firmly held. Thus the two halves of the shell are aligned once for all in the beginning, and each carries an electrode immovably secured and perfectly centred; it therefore follows that the electrodes themselves must always be in alignment. The patent gives numerous details as to the constructive features. The microphone patent, issued to E. B. Fahnestock, relates to a means for unpacking the powdered material of a microphone and keeping it continually in an unpacked condition. Combined with a granular carbon microphone is an electromagnet separate from the telephone receiving magnet. The electromagnet and the microphone are so connected that changes in the strength of the latter form a mechanical movement of the granular material sufficient to unpack the same, this movement being very much greater than any changes due to sound vibrations of the diaphragm. When the receiver is taken off the hook, should the microphone be packed, an excess current will flow, thereby energizing the magnet whereby a shock is imparted to the microphone which tends to unpack it. The telephonic relay, which was patented by F. H. Brown, consists of a strong laminated magnet of the horseshoe type having soft iron fore pieces on which are spools of very fine wire in series with each other. Arranged over the pole pieces is a diaphragm of large diameter. Opposite the outer face of the diaphragm, but not touching it, is a block of carbon arranged to make electrical contact with the diaphragm under suitable conditions. A convenient arrangement for this latter purpose consists in a series of balls arranged in seats formed in the face of the block and resting against the diaphragm, the diaphragm being inclined at an angle to the horizontal. Any vibration imparted to the diaphragm operates through the variable contact between the diaphragm and the carbon block, to vary the current flowing in the primary circuit of the induction coil, the secondary of which forms part of a circuit which operates a receiver or another relay at a distant point. In a patent granted to A. K. Keller an improvement of the ordinary form of receiver is described. The improvement consists in the provision of a metallic cup which carries the diaphragm and to which the receiver magnet is adjustably secured. The neck of the cup is threaded and the magnets are secured to a shell threaded exteriorally, which threads fit the screw threads in the neck of the cup.

LETTERS TO THE EDITORS.

The Fessenden Proposals.

To the Editors of Electrical World and Engineer:

Sirs:—The proposals of Prof. R. A. Fessenden given in complete form in your issue of Feb. 24 meet my hearty approval, and I hope that it will be possible to secure their adoption at the Paris Congress, so as to begin the coming century on a better basis. Prof. Fessenden's article is so full and clear, dealing as it does with the arguments for and against each proposed change in our definition of units, that there is little more to be said. He shows that his system will leave the ampere, coulomb, volt, ohm, farad, henry, erg, joule and watt the same as at present, as well as the magnetic line which becomes the unit of magnetism, which it already is, practically.

By assuming the permeability of the air as equal to 4π a great simplification will evidently result. So with specific inductive capacity (a very unwieldy term) a like simplification results in giving air the value $\frac{1}{4\pi}$. The amma-turn, or unit current-turn, is proposed as the magnetic potential unit, and the value is made 4π times the present unit, with the same result of simplification of formula and calculations based thereon. I think the proposal to shorten the name permeability to permity and specific inductive capacity to capity good, being more convenient to write or speak and also avoiding confusion with the older values. Some may prefer "permivity" and "capivity" as more uniform with "conductivity" and "resistivity," but for my part I would prefer to shorten conductivity to "conducity" or even "condity" and resistivity to "resity" for brevity and uniformity. By such changes in values as well as in terms, as proposed, we are conferring a benefit on all future generations of students and workers who doubtless will, in the growing complexity of life under modern and future conditions have better use for time than to waste it upon complex systems handed down.

I believe also that Prof. Fessenden's suggestions of the suffixes *sta, ma, l, r, v* and *t* for electrostatic units, electromagnetic units, etc., giving rise to the names for units, volsta, volma, volstal, coulsta, coulma, coulstar, coulmat, amma and ergav, will be found very useful; and that there is nothing which could be urged against their adoption, while there is the recommendation that the suffix at once defines the character of the unit.

There is, of course, no hope for the adoption at this time of any system which would nullify our present standards, measuring instruments, etc., but the proposals of Prof. Fessenden give no cause for apprehension on this score and could, I think, be adopted with the least possible disturbance. The result would in the future come to be regarded with much satisfaction.

SWAMPSCOTT, MASS. ELIHU THOMSON.

Rise of Temperature Formula.

To the Editors of Electrical World and Engineer:

Sirs:—The criticism by M. C. F. Guilbert of the formula of the American Institute of Electrical Engineers Standardization Committee for resistance by temperature, seems to be well taken. This formula may not be a mistake in this case, but it has been a very common one in the past, and as either it or the coefficient of .04 is incorrect, the result is objectionable as it may lead to differences of opinion. Thus, where this calculation would show a rise of 75° above 25° C., the correct value is 83°, a sufficient difference to be objectionable. Using the A. I. E. E. notation, where t and T are initial and final temperatures, R_t and R_T, corresponding resistances, a convenient and correct form is: $T = \frac{R_T(250 + t)}{R_t} - 250$.

NEW YORK. IRVING A. TAYLOR.

The Induction Motor for Electric Railway Work.

To the Editors of Electrical World and Engineer:

Sirs:—I think a considerable misapprehension has arisen in confusing the commercial induction motor for stationary work with the machine which would be designed for railway work. It is as if one solemnly set forth the fact that the average shunt wound multipolar motor could not be conveniently applied to a street car. The modern railway motor is a highly specialized machine the result of ten years of persistent modification for that purpose. On the other hand, the commercial induction motor is designed for ordinary service at the usual frequencies. The very small clearance often found is simply the cheapest way of getting a good power factor with a moderate speed motor of cheap construction as regards the windings. With a properly designed machine from 30 ~ or thereabouts there is not a bit of trouble in getting a power factor of 90 or very near it while retaining ample clearance for the purpose, and that in a motor of approximately the same commercial efficiency, speed and weight per hp as the usual railway motor. Under these conditions the wattless current bugaboo slips out of sight, particularly if one considers the ease with which the induction motor lends itself to fairly high voltages. The increase of current demand with such motors is at least no greater than the increase of energy demand caused by the losses in rotary converters. Speed regulation of induction motors may be obtained on precisely the same terms as in ordinary railway motors with rheostatic control.

To my mind, the only difficulties in the way of using induction motors are the double trolley and the extra cost of non-standard apparatus, and both of these are of moderate importance only, in the long interurban work for which an alternating distribution is most desirable. No one type of apparatus is best for all purposes, of course, and I think that induction motors assuredly have a useful field in certain classes of railway work. LOUIS BELL.

BROOKLINE, MASS.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

By CARL HERING.

DYNAMOS, MOTORS AND TRANSFORMERS.

Motor Exhibition.—A description of the exhibits at the exposition of small electric motors in Vienna. Although the motors differ greatly in type and details, some uniformity was found, as, for instance, in the tendency to obtain the greatest possible economy of weight and saving of space, also in enclosing the motor against dust, but in such a way that repairs and adjustment of the brushes can be easily accomplished. Great care is always taken to provide for good ventilation. All smaller induction motors have a short-circuited armature, with the single exception of a Schuckert motor; nearly always copper brushes have been replaced by carbon brushes; fibre insulation is seen but little; mica, micanite and other nonhygroscopic insulating materials are generally used. Continuous current and single-phase, two-phase and three-phase alternating currents are available.—*Elek. Zeit.*, Feb. 8, *Zeit. fuer Elek.*, Jan. 28.

REFERENCES.

Paralleling Single-Phase Alternators.—STANSFIELD.—A communication describing a method for detecting whether the incoming engine is going too fast or too slow. The connections of the small transformers, non-inductive resistances and three incandescent lamps are given in a diagram. The order in which the three lamps light up is different when the incoming alternator is running too fast from when too slow.—Lond. *Elec. Rev.*, Feb. 9.

Closed Circuit Armature Windings.—RICHTER.—The conclusion of his very long article noticed in the Digest Feb. 24, illustrated by several diagrams and tables.—*Zeit. fuer Elek.*, Feb. 4.

Alternators With Revolving Field.—A short article on the general advantages of the revolving field and stationary armature type of alternators. There seems to be nothing new.—*L'Elec.*, Jan. 20.

Induction Motors.—GRAUBMANN.—An illustrated description of a device by which, when the armature of an induction motor with external rheostat is short circuited after starting, the brushes are removed from the collector rings in order to prevent their deterioration.—*Elek. Anz.*, Feb. 4.

Transformers and Converters.—GUILBERT.—An article giving brief illustrated descriptions of recent improvements, taken from patent specifications.—*L'Eclairage Elec.*, Feb. 3.

LIGHTS AND LIGHTING.

Electric Incandescent Bodies.—GANS.—An article describing a method of manufacturing an incandescent body with a conductive core of carbon or metal and a cover of a metallic oxide. He applies the preparations of metal which are in commercial use for gilding, silvering, etc., porcelain or glass. For this purpose preparations of ruthenium, rhodium, osmium, are the best, which can be produced in the same way as those of gold and silver. Small rods, tubes or plates or glass or porcelain are treated with such a preparation, then the glass or porcelain is removed by means of fluoric acid or chlorhydric acid. It is not necessary to etch away entirely the glass, but only to treat it with the acid that the metal film can be removed like a stamp is soaked off from a piece of wet paper. For providing this metal film with a cover of metallic oxide he applies the so-called "lustres," which are organic compounds of metallic oxides soluble in ether oils, which are in commercial use for producing bright coatings on glass or porcelain. A mixture of 99 per cent. of thorium and 1 per cent. of cerium is the best. The metal strip, obtained by the first process, is coated with a cover of this mixture in powdered form or immersed into a solution of this mixture in an ether oil, and then the coating is burned into the metal core. A very adhesive glassy cover is thus obtained. Such incandescent bodies are claimed to be very durable and to give a bright light both in air and in the vacuum.—*Zeit. fuer Beleucht.*, Feb. 10.

Lighting Gas Burners by Electricity.—BERTHIER.—A description of several methods, used chiefly in Germany, to light gas flames from a distant central point. Two actions are necessary: the opening of the cock and the ignition of the gas. The latter can be done either by the spark of an induction coil or by a special platinum wire or by a small auxiliary flame which is always burning. In the last case electricity is used only for opening and closing the cock, which is accomplished either by an electromagnet operating a toothed wheel which opens or closes the cock, or a pole moving in a cylindric tube, the mouth of the gas tube being open, when the pole is on one side, and closed when it is on the other side.—*L'Eclairage Elec.*, Feb. 3.

Arc Lighting.—COTSWORTH.—A short abstract of a paper read before the British Institution of Junior Engineers. He reviewed the means used for working the striking and feeding mechanisms. The thermoelectric method is to be preferred to the electromagnetic. For instance, in an alternating current system an alteration in the periodicity would have no effect on the regulation, as would be the case with an electromagnetic control. Lamps made in America are nearly all controlled by a clutch, acting directly on the upper carbon guide rod; in Continental Europe a clock mechanism has found most favor; in England the prevailing type has a wheel controlled by a brake, which enables a very sensitive and accurate feed to be obtained. For series running of arcs, an automatic cutout is necessary, the best place being in the plinth of the lamp post. Alternating arcs can be run in series across the primary mains, and if provided with a small choking coil across their terminals, the extinction of one lamp does not affect the others. Another arrangement is to run alternating arcs in series with a constant current taken from constant potential mains, which is accomplished with the aid of a regulating transformer of special design. Alternating current arcs do not give the same efficiency as continuous current arcs; many of the recognized advantages of enclosed arcs are more than counterbalanced by the increased first cost, owing to the necessity of two dense opaloid globes.—Lond. *Elec.*, Feb. 9.

Train Lighting.—HOEST.—A description of a modification of the Stone system. Two accumulator batteries are connected in parallel with the dynamo and with the lamps. When the train runs in a certain direction, one battery supplies current to the lamps, and the other is charged by the dynamo; if the direction of the train is reversed,

the action of the batteries is reversed; this is accomplished by automatically inserting resistances. When the train stops, the dynamo is disconnected and both batteries supply current to the lamps. When the lamps are not lighted, while the train is running, both batteries are charged by the dynamo.—*Bull.*, p. 264; abstracted in *L'Eclairage Elec.*, Jan. 6.

REFERENCES.

Anticipations of the Nernst Lamp.—L. and C. DE SOMZEE.—An illustrated article on various anticipations of this lamp, by Jablochkoff, Edison, Van Gestel and Beck, and Wattis-Boliasnyg.—*L'Elec.*, Jan. 20.

Long Filaments for Incandescent Lamps.—A. B.—Some criticisms of the article noticed in the Digest Nov. 11. He does not believe that long filaments have great advantages in the life of the lamp, but is certain that they offer great difficulties for high voltage lamps.—*L'Elec.*, Feb. 10.

Train Lighting.—ADAMS.—A description of some systems of electric train lighting. It seems to contain nothing new.—*Sc. Amer.*, March 3.

POWER.

REFERENCES.

Trenton Falls.—GRATACAP.—A short article on the project to utilize the power of Trenton Falls, New York State, which may reach 5000-hp, for transmission to Utica.—*Sc. Amer. Sup.*, Feb. 24.

Continuous Current Power Transmission.—CUENOT.—A longer abstract of the paper noticed in the Digest Feb. 24.—*L'Eclairage Elec.*, Jan. 20.

TRACTION.

Efficiency of Motormen.—HEWITT.—A paper read before the Engineers' Club, of Philadelphia, giving an account of a series of tests made on several lines of the Philadelphia tramways. With the same car, same motors, same track, in fact with all conditions the same except the motorman, the watt-hours used per car mile show the relative economy of the different men. From his records he deduces the following observations: As a rule the record for any one man is fairly uniform; a man who is economical at one time is nearly always economical. The difference between the men is due almost entirely to the manner in which they handle the controller, and but very little to the number of passengers or condition of the rail. A saving of about 20 per cent. of power can be accomplished by special instructions to the motormen. The difference in the amount of power used per car mile is shown in two tables. The first is arranged according to the average power used per trip irrespective of motormen, and shows that the excess of the maximum power over the average in per cent. of maximum, on three different lines, is 16.5, 20.3, 15.2. The second table is arranged according to the average power per man irrespective of trips, and shows an excess of highest over lowest in per cent. of lowest on two lines, of 49 and 43 per cent.; on a third line 43 per cent. without special instructions and 63 per cent. under special instructions. While it is impossible to attain the ideal saving of about 45 per cent., he believes it is possible to reduce the maximum to the average of the records, or, in other words, secure a saving of about 20 per cent. If the average output of the station is about 1300 watt-hours per car mile, and the cost of a kw-hour is 1½ cents, a saving of 20 per cent. is found to amount to $185 per car for a year of 365 days. The extra care in running due to the effort to save power, would also reduce materially the number of accidents; it would also add just so much to the reserve power in the station and transmission line. In the discussion which followed Furber remarked that the differences in the power used might possibly be explained by incidental conditions of loading, such as a football game, a parade, etc., but the author said that this is not the case; he added that the fact that on one line the average power was considerably greater than on the other two, was due to the difference in the armature windings; on that special car they were three-turn armatures, wound so for rapid acceleration, and the results show that they are not as economical for city service as the four-turn armatures. Hering remarked that if so great a saving can be effected by individual motormen in the handling of the controller, it would be worth the expense to instruct them still more thoroughly by sending an expert with them on some of the trips to give instructions as to the best way to use the controller; the motormen seem to move the handle to the last notches altogether too quickly. They should run on the first notches until a certain speed has been attained, and then go on to the other notches.—*Proc. Eng. Club of Philadelphia*, February.

Electric Traction in the House.—An illustrated article on a trolley system for office purposes, using a small suspended car carrying a case and driven by a 1-10-hp motor. The current is supplied by a bare copper wire. The ends of the line are not in circuit and are inclined so that the car stops by itself. The system is in use in the offices of a German insurance company.—*Zeit. fuer Elek.*, Jan. 28.

Electric Traction in Moscow.—KRANNHALS.—An illustrated description of the first four electric tramway lines of Moscow, the whole length being 5.7 miles. Three-phase current at 2000 volts is furnished to the station where it is transformed into continuous current of 550 volts by means of four three-phase motors, coupled to continuous current generators. There is a storage battery of 275 cells, giving 1000 amp.-hours at a rate of 400 amp. The trolley system is used. Trials are being made with an accumulator car, provided with a battery of 200 Tudor cells, each of 30 amp.-hours, of 2.8 tons weight; the current for driving the motors can be furnished either by the trolley system or by the accumulators charged from the trolley wire.—*Elek. Zeit.*, Feb. 8.

Naples.—ALFIERI.—A paper on the tramway lines of Naples. Two steam driven dynamos give current of 150 amperes at 575 volts; there is also a battery of 300 Tudor cells with a capacity of about 1400 amp.-hours; 15 motor cars and 10 trailers are in use. The motor cars are driven by 25-hp motors of the General Electric Company of this country.—*Atti della Assoc. Elett. Ital.*, No. 5, 1899; abstracted in *Zeit. fuer Elek.*, Feb. 11.

REFERENCES.

Accumulators.—BAINVILLE.—Continuations of the illustrated description of the accumulators which were entered in the recent Paris tests (Digest, March 3). Tudor, Pescetto, *L'Elec.*, Feb. 3; Chloride, Pollak, Tudor, Pescetto, *L'Eclairage Elec.*, Jan. 27; Blot-Fulmen, Fulmen, Phenix, Pope, *L'Elec.*, Feb. 3, and *L'Eclairage Elec.*, Feb. 3.

Automobile Accumulators.—BAINVILLE.—A German translation of the French article noticed in the Digest Jan. 20.—*Elek. Anz.*, Feb. 8.

Automobile Frame.—An illustrated translation of the French article on the Solignac frame, noticed in the Digest Feb. 10.—*Sc. Amer. Sup.*, Feb. 24.

Electric Traction.—BAXTER.—The concluding part of his illustrated article on "What makes the trolley car go," describing underground conduits, the third rail system and electric locomotives.—*Appleton's Pop. Sc. Monthly*, March.

Accumulator Traction.—ALBRECHT.—An abstract of the article noticed in the Digest Feb. 17.—Lond. *Elec. Eng.*, Feb. 9.

Trolley Wires Over Movable Bridges.—An illustrated description of the arrangement of the trolley wires over two movable bridges in Hull, with self-engaging switches. The feeders and the return currents from the rails are conveyed under the river.—Lond. *Elec. Eng.*, Feb. 9.

Rail Bonds for Tramways.—ZALESKI.—An illustrated description of the Edison-Brown, Chicago, Couronne and Vedovelli bonds.—*L'Eclairage Elec.*, Jan. 27.

Cannes.—HEDGES.—A short article on the development of electric traction on the Riviera. The tramways of Cannes extend over 13¼ miles. The trolley system is used.—Lond. *Elec. Rev.*, Feb. 9.

Coventry.—A reprint of the illustrated article on this English tramway line, noticed in the Digest March 3.—*El'ty*, Feb. 21.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Behavior of Storage Batteries.—BRANDT.—A communication referring to the article of Kohn, abstracted in the Digest Feb. 24. He agrees that his graphical method may be used to advantage in special cases, but says that it is not correct in general, as the action of a storage battery cannot be represented graphically by a constant characteristic curve. The form of the characteristic curve varies with the time and depends largely upon the action of the battery in the preceding time. When the battery has been neither charged nor discharged for some time, the characteristic curve is nearly a straight line for the first moments of charging or discharging. After some time, however, the parts of the curve representing the charge or discharge are inclined with different angles to the axis or ordinates; the inclination of the charging curve after three minutes of charging is about twice the inclination of the discharge curve after three minutes of discharging. Therefore in Kohn's graphical method for each moment another characteristic curve of the battery would have to be used. He refers to his experiments which caused him to introduce the term "characteristic resistance" of a battery, and reproduces his method to predetermine a battery (Digest, Nov. 11).—*Elek. Zeit.*, Feb. 8.

Car Lighting Installations.—An illustrated description of a trailer car used by an Italian steam railway company (Digest, Jan. 6) for urgent repairs in the stations and along the lines and as a movable lighting plant, in accident cases. The car contains a steam boiler, a steam engine and a dynamo, generating current of 60 amp. at 65 volts, also 5 arc lamps, 40 incandescent lamps of 32-cp and 40 of 16-cp, globes, reflectors, a cable reel able to take a cable of 1286 feet, etc. —*Genie Civil*; *West. Elec.*, Feb. 24.

REFERENCES.

Electric Installation of the Paris Exposition.—A continuation of the article abstracted in the Digest March 3. The official regulations regarding the power transmission, the elevators, the overhead tramways, the installation of the generators are reprinted; also the contract with a company for installing distribution mains and furnishing power.—*L'Ind. Elec.*, Feb. 10.

Distribution of Electricity.—DE CONTADES.—An illustrated article of a general nature, describing some systems of power distribution with continuous currents.—*Cosmos*, Feb. 17.

Niagara Falls.—A well illustrated series of articles, filling the whole issue, on the industrial utilization of the power of the Niagara Falls.—*Sc. Amer. Sup.*, March 3.

WIRES, WIRING AND CONDUITS.

Long Span.—A brief illustrated description of the span across the Connecticut River for long distance telephone lines. Overhead lines were used in place of a submarine cable, in order not to impair the efficiency of the circuits on account of their induction and capacity. The span is 1300 feet long; the wires are suspended between two high steel towers, one of them 182 feet and the other 82 feet high; the capacity is 40 wires, of which 20 are now strung. It was necessary to have them all of equal tension to avoid crosses due to the wind, and therefore each wire is attached to a tension device. What is called phonoelectric wire is used, consisting of a copper alloy; it is 0.165-inch in diameter, and has a tensile strength of 82,000 lbs. per square inch.—*Elec. Rev.*, Feb. 21.

Long Span.—A brief illustrated description of the plant in Wisconsin in which there is a single span of 1100 feet across the Wisconsin River, and which is said to be one of the longest spans of electric line wires in existence; there are two parallel wires 20 feet apart running between the tops of rather short poles.—*West. Elec.*, Feb.24.

REFERENCES.

Graphic Calculation of Underground Three-phase Concentric Cables.—GUYE.—A theoretical article, in which he treats the case of a three-phase concentric cable. The capacity distributed over its whole length is replaced by one conductor shunted across the line at the middle and the graphical method is used to show the phenomena due to the capacity.—*L'Eclairage Elec.*, Jan. 20.

Aluminum Wires.—MASSIN.—A longer abstract, with a diagram, of his article against the use of aluminum wires for telegraph and telephone lines, noticed in the Digest Jan. 13.—*L'Eclairage Elec.*, Jan. 27.

Wire.—BRUNTON.—A paper read before the Scotch Iron and Steel Institute, on the methods used in the manufacture of wire.—*Ind. and Iron*, Feb. 9.

Protection of Telephone Wires.—MOENS.—An abstract of a paper read before the Montefiore Association on the various systems intended to prevent the danger of a contact between telephone and telegraph wires and trolley wires; also of the discussion which followed. —*L'Eclairage Elec.*, Jan. 6, 20.

ELECTRO-PHYSICS AND MAGNETISM.

Theory of the Induction Coil.—ARMAGNAT.—An article calling attention to the fact, proved by Mizuno's experiments, that if an induction coil and a current are given, there is a certain capacity of the primary condenser for which the length of the sparks is a maximum. This fact is not explained by the ordinary theories of the induction coil. He gives an outline of a new theory in which he considers the changes of the energy due to spark discharges, and the action of the interrupter, and draws the conclusion that the speed of the mechanical interrupters should be as high as possible at the moment of rupture. There are, however, practical reasons which limit the speed.—*L'Eclairage Elec.*, Jan. 27.

Conductivity of Amalgams.—LARSON.—An account of the measurements of the conductivities of the amalgams of lead, zinc, cadmium, tin and bismuth. The change of conductivity, as compared with that of pure mercury, is plotted in curves. The relative conductivities increase in proportion to the temperature; this increase increases still more with the concentration of the amalgam, though not quite as rapidly. The results indicate that in dilute amalgams there is a dissociation which increases with the temperature.—*Ann. der Physik*, No. 1; abstracted in Lond. *Elec.*, Feb. 9.

Piezo-Electricity.—NACHTIKAL.—An account of experiments showing that the piezoelectric charges are nearly proportional to the pressures producing them, the deviations from proportionality being quite small. At the higher pressures, quartz shows a deficiency of piezoelectric charge, while tourmaline shows a slight excess over the expected value.—*Gesell. Wiss. Göttingen, Machr. Math. Phys. Klasse*, 1, p. 109; abstracted in *Science Abstracts*, January.

Photoelectric Phenomena.—SCHWEIDLER.—An account of experiments showing that from a given point onwards, the photoelectric current increases more rapidly than the potential difference of the electrodes. At low pressures this behavior begins at potentials which are relatively small as compared with the potential at which spark discharge begins. At atmospheric pressure it only begins in the neighborhood of the discharge-potential, and is then very rapid.—*Sitzber. Akad. Wiss. Wien.*, 108, p. 273; abstracted in *Science Abstracts*, January.

Peltier Effect in a Magnetic Field.—POCHETTINO.—In an iron couple, the value of the coefficient of the Peltier effect varies with longitudinal magnetization, first increasing to a maximum value of 0.008968 in a field of 98 c. g. s. units, then decreasing and passing through its normal value at a field strength of about 345 units. The variations in the Peltier effect are independent of the direction of the magnetization, so that the magnetizing current may be reversed without affecting the result.—*Accad. Lincei Atti*, 8, p. 50; abstracted in *Science Abstracts*, January.

Magnetic Twist in Nickel Tubes.—KNOTT.—A discussion of the relations between the elongations accompanying the magnetization in iron and the twist produced in an iron wire under the combined influence of longitudinal and circular magnetizing forces. Both phenomena are intimately connected. Both effects are reversed in the case of nickel. He also found that the circular magnetization in a given field is greater than the longitudinal magnetization in the same field, because the demagnetizing factor is greater in the latter case.—*Proc. Roy. Soc., Edinburgh*, December; abstracted in Lond. *Elec.*, Feb. 9.

Magnetic Properties of the Elements.—MEYER.—A long illustrated abstract of a paper, read before the Electrotechnical Society of Vienna, giving a summary of his researches. He describes the methods used by him in the measurements of the magnetic properties of the elements in fluid, powdered or solid form, and gives a general summary of his results, as noticed in the Digest Aug. 5 and Oct. 28. In the periodic curve, in which the ordinates represent the atomic weights and the abscissas the atomic volumes, the paramagnetic elements are situated at the minimum points, or in the descending parts of the curve, the diamagnetic elements in the ascending parts.—*Zeit. fuer Elek.*, Feb. 11.

Magnetic Properties of the Elements.—KOENIGSBERGER.—An article showing that the same metal may be diamagnetic in one state of valency and paramagnetic in the other. Cuprous compounds are diamagnetic, while cupric compounds are paramagnetic. A compound formed of two diamagnetic substances may be paramagnetic. The mechanical treatment of wire drawing produces a well marked effect upon the magnetic susceptibility in certain directions.—*Ann. der Physik*, No. 1; abstracted in Lond. *Elec.*, Feb. 9.

Magnetization of Bricks by Burning and by Lightning.—A short article based upon an investigation of Gamba, showing the differences. The magnetism, produced in bricks by the burning in the furnace under the influence of the terrestrial magnetism is very weak, but the direction of the magnetization is well defined. The magnetism, produced by lightning, is much greater, but no defined direction of the lines of magnetic forces can be found.—*Cosmos*, Jan. 20.

REFERENCES.

Variation of Resistance.—CHEVALLIER.—A French Academy note on the permanent modifications of metallic wires and the variation of their electric resistance. If a metallic wire is submitted to periodic variations of the temperature, its electric resistance varies in a very irregular manner; this is the case especially with metals or alloys which are not cold hammered.—*L'Ind. Elec.*, Feb. 10; *L'Eclairage Elec.*, Jan. 27.

Spectrophotometry of Continuous Current Arc Lamps.—LEHMAN-RICHTER.—A French abstract of the German article noticed in the Digest Nov. 18.—*L'Eclairage Elec.*, Jan. 27.

Electrostatic Rotation.—DELL.—An account of further experiments with a rotating disc (Digest, Feb. 3). He tries to explain the rotation and gives a description of the disc in detail.—*Elec. Rev.*, Feb. 21.

Atmospheric Potential.—DEXTER.—A short article on the electrical potential of the atmosphere referred to other conditions, which is an outline of the attempt to show the relation between electrical potential of the atmosphere and other meteorological conditions.—*Sc. Amer. Sup.*, Feb. 24.

Contact Theory.—MAJORANA.—A paper describing his experiments, noticed in the Digest Sept. 30 and Nov. 4.—*Atti della Assoc. Elett. Ital.*, No. 5, 1899; abstracted in *Zeit. fuer Elek.*, Feb. 11.

Law of Electromagnetism.—RAVEAU.—A French Academy note criticising the fact that some points in the theoretical and experimental development of the elementary law of electromagnetism are usually neglected as unimportant; also contesting the correctness of the conclusions of Lecher noticed in the Digest Feb. 10.—*L'Ind. Elec.*, Jan. 25. A fuller account of his investigation is given in *L'Eclairage Elec.*, Feb. 3.

Thermomagnetic Effect in Bismuth.—YAMAGUCHI.—An account of an experimental investigation of the thermomagnetic transverse effect, discovered by Ettinghausen and Nernst. The effect depends upon the increase of resistance experienced by bismuth in the magnetic field, which he found to be doubled or trebled as the temperature falls from -30° to -120°.—*Ann. der Physik*, No. 1; abstracted in Lond. *Elec.*, Feb. 9.

Radiography.—DELEZINIER.—A French Academy note recommending the use of three-phase currents for radiography, which by means of a special arrangement makes the results independent of the connections of the anode and cathode of the tube to the induction coil with respect to polarity.—*L'Ind. Elec.*, Feb. 10.

Becquerel Rays.—An editorial giving a summary of the present knowledge of Becquerel rays.—*Elek. Zeit.*, Feb. 8.

Absorption of Radium Rays.—MEYER and SCHWEIDLER.—An account of experiments showing that the rays in their entirety are the sum of different rays of various absorptive power.—*Phys. Zeit.*, Feb. 10.

Rays.—ELSTER.—A brief abstract of a lecture held before the German Physical Society, on visible and invisible rays, giving an outline of the recent progress of our knowledge of cathode rays, etc.—*Elek. Anz.*, Feb. 1.

Surface Electrification of Vacuum Tubes.—RIECKE.—An illustrated abstract of the article noticed in the Digest Feb. 10.—*Elek. Zeit.*, Feb. 1.

ELECTRO-CHEMISTRY AND BATTERIES.

Accumulators for Traction.—ZACHARIAS.—A description of some novelties in accumulators for traction purposes. One method of manufacturing positive plates of the Planté type is called the "Monobloc," used by a company in Brussels. The positive plate is formed of a compact block consisting of about 120 sheets of lead, each 0.02-inch thick, held together by a hard lead frame and four corner pieces burnt on to the lead sheets. The plates are perforated according to their size, with from 20 to 30 holes, 0.4-inch apart. The negative plates are composed of quadrangular tubes 0.02-inch thick, which are formed of lead hardened with a very little antimony. The tubes are filled with highly porous and spongy lead, and are provided with numerous longitudinal openings. These accumulators have been in use more than a year; on the Belgian state lines the cells required cleaning only after 12,500 miles had been run. In the Blot accumulator rolled lead is used for the positive plates in the form of long strips rolled up so as to fit into receptacles in the plate. The chief drawback to plates of the Planté type is no longer their weight, but the time required for their formation.—*Centralblatt fuer Accum.*, No. 1; abstracted in Lond. *Elec.*, Feb. 9.

Galvanic Cell.—ZACHARIAS.—An illustrated article on improvements of the Leclanché type. All cells, in which manganese cylinders are used to obtain a greater surface, have certain disadvantages; the depolarizing action of the manganese, contained in burned cylinders is not sufficient to enable a larger current to be taken from the cell; they can be discharged with not more than 0.3 amp., if they are to be used for a longer time. The internal resistance is considerable and the pores of the manganese cylinders are soon filled with insoluble salts of zinc. The first improvement was made by Vogt in the Gnom cell, the electrodes of which are a zinc cylinder and a carbon rod covered with the depolarizer, consisting of three parts of manganese and one part of graphite; the depolarizer acts very well and the cell has a small internal resistance. A further improvement has been made in Pfannenberg's reform cell which is illustrated. In order to give a great surface to the carbon and to apply a great quantity of depolarizer, he uses two carbon rods of oval cross-section, connected at the upper ends by a carbon plate. The zinc electrode consists of a cylinder around both rods and a plane plate between the rods. An 8-inch cell has such a small internal resistance that it gives 30 to 35 amp. when short circuited. In a discharge of two cells (apparently through a constant resistance) the voltage at the beginning was 1.48, after 12 hours 1.07, after 20 hours 1.01; the current was 1.10, 0.7 and 0.65 amp. respectively. He found that an electrolyte supplied with salammoniac calcidum gives better results than salammoniac.—*Centralblatt fuer Accum. u. Elem. kunde*, Jan. 15.

Dry Cells.—BERTHIER.—An illustrated description of some new dry cells which have been brought into use with electric bells and with benzine motors. Most of them, like the Etoile cell, are only modifications of the Leclanché cell. Two other new cells are the Hydra (Digest, Jan 27) and the Columbus cell. The feature of the latter is its enclosure, which is tight for liquids, but allows the gases to escape; this is accomplished by closing the upper part by a plug of oiled felt, the whole inner part is filled with the active solution.—Cosmos, Feb. 10.

Purification of Water by Ozone.—An abstract of the discussion which followed a paper on this subject read by Dr. Soper before the New England Water Works Association. Prof. Kennicut spoke on the possibility of cheapening the production of ozone in the future and mentioned the new method of obtaining it by adding fluorine gas to water. Dr. Soper said that water was not a solvent for ozone and did not retain it. The treated water produced no ill effects upon the human system. In purifying water by ozone, it is necessary to remove the larger masses from the water before ozonization by preliminary filtration or straining, as otherwise the oxidizing power of the gas would be used on this matter. This method would perhaps be especially applicable to the effluent of a filter which was giving unsatisfactory results either because it is overworked or improperly operated.—*Eng. News*, Feb. 22.

Automatic Charges and Discharges of Accumulators.—SCHOOP.—A short illustrated article describing an automatic device for producing continuous charges and discharges of a battery, which may be used to determine the life of an accumulator. One of the cells of the battery is connected with a contact voltmeter which is adjusted between the limits 2.7 volts and 1.8 volts. As soon as one of these limits is reached a relay circuit is closed which acts upon an electromagnet and reverses a commutator in the main circuit.—*Zeit. fuer Elek.*, Feb. 11.

Ionization of Sulphuric Acid.—STARCK.—A paper showing that probably sulphuric acid in aqueous solution is dissociated into the ions H, SO_4 and HSO_4, and that the relative quantity of the last increases with the concentration of the acid. This is concluded from measurements of the migration constant of the anion for different concentrations.—*Zeit. fuer Phys. Chem.*, 29, p. 385; abstracted in *Science Abstracts*, January.

Sweden.—CARLSON.—An abstract of a German Electrochemical Society paper on the electrochemical industry in Sweden, for which at present 25,000-hp are available. In Sweden wages are low and there is an abundance of water power. The main industry is calcium carbide; chloride of potassium, chlorine, soda, iron, zinc and aluminum are also produced. Electrolytic bleaching is only little in use. On many places electrolysis is used in the sugar industry, and for the past five years also in tanning; electrolytically treated leather is said to be less durable but cheap.—*Elek. Zeit.*, Feb. 8.

REFERENCES.

Electric Tanning.—An article on the use of electricity for quicker and better tanning in a drum, as noticed in the Digest Sept. 23. The current is 7 amp. for light skins and 15 amp. for heavy skins, the voltage being 70.—*Die Elektricitat*, 5, 160; abstracted in *Elektrochem. Zeit.*, Feb. 1.

Charging Accumulators.—SCHIFF.—A short article giving some practical hints regarding the voltage regulation in charging and discharging accumulators.—*Elektrochem. Zeit.*, Feb. 1.

Electrolytic Production of Coloring Matter.—SZARVASY.—An illustrated account of experiments showing that by the electrolysis of salts of aniline, coloring matter of the induline type can be obtained.—*Zeit. fuer Elektrochemie*, Feb. 1.

Calcium Carbide.—CARLSON.—A long French abstract of the German article noticed in the Digest Jan. 13.—*L'Eclairage Elec.*, Jan. 20.

Spongy Zinc.—FOERSTER and GUENTHER.—A French abstract of the German article noticed in the Digest Dec. 30.—*L'Eclairage Elec.*, Jan. 27.

Electrolysis of Chloride of Potassium.—BROCHET.—A French Academy paper giving an account of an investigation relating to the formation of hypochlorites and chlorates.—*L'Ind. Elec.*, Feb. 10; *L'Eclairage Elec.*, Jan. 27.

Velocities of Ions in Electrolysis.—MASSON.—A long paper in which he criticises the methods of Hittorf, Kohlrausch, Lodge and Whetham, and describes his own. The results of his experiments with a number of different electrolytes are given in tabular form.—*Zeit. fuer Phys. Chem.*, 29, p. 501; abstracted in *Science Abstracts*, January.

Ionization of Good Electrolytes.—EULER.—An article in which he endeavors to find out why some salts do not follow Ostwald's dilution law. He assumes a "change of ionizing power of the solvent by the dissolved salt."—*Zeit. fuer Phys. Chemie*, 29, p. 603; abstracted in *Science Abstracts*, January.

Electrolytic Potential.—SCHUEKAREW.—A short paper introducing a function called "electrolytic potential," into the theory of solutions, and developing a dilution formula which is shown to hold well for solutions of acetic acid.—*Zeit. fuer Phys. Chem.*, 29, p. 726; abstracted in *Science Abstracts*, January.

Electrochemistry in 1899.—KRUEGER.—An outline of the progress in 1899 in electrochemical science, in primary and secondary batteries, electrometallurgy and galvanic plating, giving very brief descriptions, most of which are taken from patent specifications.—*Elektrochem. Zeit.*, Feb. 1.

UNITS, MEASUREMENTS AND INSTRUMENTS.

REFERENCES.

Electric Units.—An article summarizing the systems proposed by Heaviside, Fessenden and Fleming (Digest, Jan. 20, Feb. 3, 10). Also an editorial saying that Prof. Fessenden's ingenious proposal "seems useful and unobjectionable," while Prof. Fleming's proposal to change the present units of ohm, ampere, watt and microfarad, by multiplying or dividing by 10, would cause the greatest confusion and the most troublesome mistakes, just on account of its apparent simplicity.—Lond. *Elec. Rev.*, Feb.

Hour Meter.—ALIAMET.—An illustrated description of the multiple hour meter of Villy, which is intended for the same purpose as that of Cauderay, noticed in the Digest Jan. 7, 1899. The lamps of the consumer are connected to different circuits and the hours during which the current flows in each circuit are registered on a separate dial. The details of the mechanism are described and illustrated.—*L'Elec.*, Jan. 20; *L'Energie Elec.*, Dec. 16.

Wehnelt Interrupter.—RUHMER.—A continuation of his experiments noticed in the Digest Dec. 2. He finds that Simon's theory holds good also for the Caldwell-Simon interrupter.—*Phys. Zeit.*, Feb. 10.

Bolometer.—MARMOR.—An article on the bolometer and its applications.—*Cosmos*, Jan. 20, 27.

Cable Testing Station.—A description of a station for testing the insulation of cables, with diagrams showing the arrangements for the tests.—*Elek. Anz.*, Feb. 4.

Analysis of Higher Harmonics of Alternating Currents.—ZENNECK.—An illustrated abstract of the article noticed in the Digest Jan. 27.—*Elek. Zeit.*, Feb. 1.

Doubling the Periodicity of Alternating Currents.—ZENNECK.—An illustrated abstract of the article noticed in the Digest Jan. 27.—*Elek. Zeit.*, Feb. 1.

Photographing Current Curves.—WEHNELT and DONATH.—An illustrated abstract of the article noticed in the Digest Feb. 3.—*Elek. Zeit.*, Feb. 1.

Photographing Current Curves.—SEEFEHLNER.—The conclusion of his illustrated article noticed in the Digest Feb. 24, including a number of reproductions of photographs of curves.—*Zeit. fuer Elek.*, Jan. 21, 28.

Photographic Current Curves.—ZENNECK.—An illustrated abstract of the article noticed in the Digest Feb. 3.—*Elek. Zeit.*, Feb. 1.

Testing Meters.—SAHULKA.—A very long illustrated French abstract of the German article noticed in the Digest Oct. 14.—*L'Eclairage Elec.*, Feb. 3.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Wireless Telegraphy.—MARCONI.—A long illustrated abstract of his Royal Institution lecture on recent progress in wireless telegraphy; the lecture is also discussed editorially. The gap of filings in the coherer has undergone an extreme diminution. The width of approximate Lodge's point coherer, with the exception that the gap filings between the two silver electrodes has now been reduced to one millimeter, and if a further reduction is made the tube will soon is in vacuo. A more important practical improvement is the introduction of a special form of induction coil (Digest, Oct. 28) in connection with the receiving instruments; merely by adding this simple appliance to the apparatus used during the naval maneuvers, and without otherwise altering the conditions in any way, the maximum possible signaling distance was increased from 7 to 60 miles. Methods of confining messages to the instruments destined for their reception, were not mentioned at all.—Lond. *Elec.*, Feb. 9. More briefly abstracted in Lond. *Elec. Eng.*, Feb. 9; *Lightning*, Feb. 8.

REFERENCES.

Self-Induction of Cables.—BREISIG.—An illustrated translation of the German article, abstracted in the Digest Dec. 30.—Lond. *Elec.*, Feb. 2.

Telephone System for Party Lines.—WEST.—A reprint of the illustrated article, abstracted in the Digest Feb. 24.—*El'ty*, Feb. 21.

Railroad Signals.—COLEMAN.—The conclusion of his long illustrated serial on electropneumatic, interlocking signals at the New South Terminal Station in Boston (Digest, Feb. 10). The signal lever, the switch lever, the interlocking machine, the track model and the lever arrangement, are described.—*Railr. Gaz.*, Feb. 9, 23.

Another illustrated article on this system also in *Sc. Amer.*, March 3.

Railway Signals.—VIRGILITO.—A paper describing his automatic electric block signal system which is a modification of that of Hall.—*Atti della Assoc. Elett. Ital.*, No. 5, 1899; abstracted in *Zeit. fuer Elek.*, Feb. 11.

MISCELLANEOUS.

Soldering, Zincing and Tinning of Aluminum.—KRAUSE.—A note on the difficulty of keeping the surface of aluminum clean and bright, which is necessary for soldering, as the surface tends to be covered in the air by a film of oxide. This can be prevented by avoiding contact with the air. The soldering oven has a tank with liquid solder consisting of equal parts of zinc and tin. The pieces to be soldered are put into this tank and their contact surfaces are then cleaned with a file so that the bright metallic surface is covered with the liquid solder. The solder does not adhere at other points of the aluminum, as the film of oxide prevents it. The two surfaces, to be soldered together, are to be provided with liquid solder separately, then they are placed together in the tank and pressed together. For very strong joints, pure zinc is used as liquid solder.—*Elek. Anz.*, Feb. 1.

Casting Porcelain.—A note stating that a new process which is said to give satisfactory results, has been devised in which the porcelain is melted in an electric furnace at a temperature of 3200° C., and is then run out into molds; it comes out with a highly enameled surface and completely finished.—*West. Elec.*, Feb. 17.

Electrolytic Cartridges.—A short description of a system of electrolytic cartridges devised by Tommasi, to replace those of dynamite and powder. One type consists of closed glass cylinder with thick walls, filled with a concentrated solution of carbonate of potassium. Platinum wires passing through the ends are connected to a battery of accumulators. When electrolysis occurs, the carbonate is decomposed into hydrogen and carbonic acid, so that the pressure in the cylinder increases until it explodes. Another type is filled with chloride of ammonium. Such cartridges are harmless before the electrolysis begins.—*Elektrochemie*; *Cosmos*, Jan. 27.

India Rubber from Bolivia.—CONWAY.—An abstract of a paper on the undeveloped resources of Bolivia. The india rubber industry in that country is being developed quickly; in 1893-4 the export of Mollendo rubber was 37,587 lbs., in 1897-8 it was 491,087 lbs. It is of exceedingly good quality, commanding almost as good a price in the market as Para rubber.—Lond. *Elec. Eng.*, Feb. 9.

X-Rays for Cancers.—A note stating that Dr. Selfridge, of Oakland, Cal., has entirely healed a cancer on his face by means of X-rays. The idea was that these rays would dry up and heal the cancer tissue; the experiments began in October. Editorially it is stated that the report will be received with caution by medical men; it is suggested that the growth might not have been true cancer and that it might reappear.—*West. Elec.*, Feb. 24.

REFERENCES.

St. Petersburg Congress.—A brief account of the proceedings of

the first congress of Russian electrical engineers, held in St. Petersburg in January; 320 engineers were present. The following papers were read: Ssokolski, on a governmental inspection of the electric installations inside and outside of St. Petersburg; Kurbatow, on the different types of preparatory schools for electrical engineering; Kohan, on statistics of electric railways; Dobelius, on the determination of the mean power for an electric tramway; Woinarososki, on a mixed system of electric traction; Kowalew, on the precautions taken by the Helios Company to insure a non-interrupted supply of electric current to the consumers; Perski, on the life and work of Jablochkoff. The papers are not abstracted. An extended discussion was held on the use of electricity for soldering metals which is forbidden by law in Russia on account of an alleged lack of durability; a motion was carried to request the government to allow electric soldering and smelting of metals; also a motion to establish a system of control of electric installations by the government over the country with the main office in St. Petersburg.—*Elek. Zeit.*, Feb. 1, 8.

Applications of Electricity.—A series of articles on the progress in 1899. The first, by Reyval, treats of the generation and distribution of energy. The development of the Paris central stations and the use of double current generators in Chicago are discussed and a brief outline is given of the progress in the theory of continuous and alternating current machines. The second article, by Pellissier, gives a summary of the development of electric traction. The third, rather long article, by Reyval, deals with electrochemistry and electrometallurgy, chiefly with the production of calcium carbide and acetylene, alkalies and chlorine, alkaline chlorates, hypochlorites, ozone, aluminum, copper and zinc.—*L'Eclairage Elec.*, Jan. 20, 27, Feb. 10.

Magnalium.—An article on the properties of this new alloy and its applications (Digest, Oct. 21, Nov. 11).—*Prometheus,* translated in *Sc. Am.*, Feb. 10; reprinted in *Elec. Rev.*, Feb. 21.

Magnetic Separator.—An illustrated description of a magnetic separator devised by Bromilow, which is intended specially to separate the copper, the bronze and the brass from the iron and steel in the shavings, turnings or filings of workshops.—*L'Eclairage Elec.*, Feb. 3.

Science Abstracts.—The index to Vol. II contains a good list of journals, with prices and publishers.—*Science Abstracts,* Index to Vol. II.

Austria and Hungary.—Honigmann.—A long statistical article on the electrotechnical industries of Austria and Hungary, which has not yet developed to the same degree as in other countries. The accumulator industry is rather extended.—*Elek. Zeit.*, Feb. 8.

Paris Exposition.—A list of the international congresses which are to be held in Paris during the exposition, giving the dates, the names and residences of the presidents and secretaries, and the price of membership.—*L'Ind. Elec.*, Feb. 10.

Vulcanized India Rubber.—MacGregor and MacDonald.—A short paper describing experiments for determining the rigidity under tension by the method of oscillation. Some of the observations were applied also to the determination of Young's modulus.—*Proc. N. S. Inst. of Sc.*, Vol. 10.

Electric Shocks.—An article on causes of death by electricity, based upon researches of d'Arsonval and Cunningham.—*Brit. Med. Jour., West. Elec.*, Feb. 17.

New Books.

BOOKS RECEIVED.

Electric Wiring. By Cecil P. Poole. New York: The Power Publishing Company. 101 pages, 43 illustrations. Price, $1.00.

Indicator Diagrams. A Treatise on the Use of the Indicator and its Application to the Steam Engine. By W. W. F. Pullen. Manchester, England: The Scientific Publishing Company. 238 pages, 261 illustrations. Price, 6s. net.

National Electric Light Association. Report of the Twenty-second Annual Convention, held at New York, May, 1899. Published by order of the Executive Committee. New York: The James Kempster Printing Company. 330 pages, 34 illustrations.

Directory of Electrical Societies, Etc.

Northwestern Electrical Association. Next meeting, Waupaca, Wis., June 26, 27 and 28, 1900.

Chicago Electrical Association. Next meeting, March 16. Paper: "Arc Lighting," by F. N. Boyer.

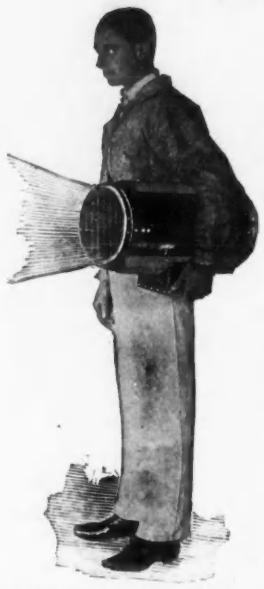
American Institute of Electrical Engineers, New York. Next meeting, March 28.

Canadian Electrical Association. Next meeting, Ottawa, Ont., June 27, 28 and 29.

American Street Railway Association. Next meeting, Kansas City, Mo., Oct. 16, 17, 18 and 19, 1900. For list of papers, see Current News and Notes.

National Electric Light Association. Next meeting, Chicago, May 22, 23 and 24, 1900.

Portable Searchlight.



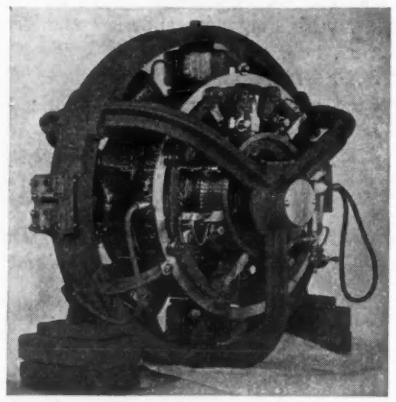
PORTABLE SEARCHLIGHT.

The accompanying cut shows a portable searchlight having all the essential features of the large projectors. Briefly stated, the parts consist of a cylinder, carrying an automatic focusing arc lamp, the carbons feeding horizontally. The arc is in the focus of a Mangin mirror having a diameter of 7 inches. The lamp is so arranged that it can easily be brought in or out of focus, so that the beam of light may be diffused or concentrated as desired. The total weight when constructed of aluminum is 15 lbs., or in brass 20 lbs. With 10 amperes of current at 55 volts, it is stated that a beam is developed effective at a distince of half a mile.

In addition to availability for service on board ships as an ordinary projector, this light is applicable on shore along the river front in docks during loading or discharging cargo, coaling, etc. To a fire department it should also be a valuable adjunct. The light could be carried by the battalion chief, connected to the dynamo on the engine, ready for instant use. Other directions in which this light is valuable may be mentioned such as mining work, military field service, life-saving stations, etc. This searchlight is manufactured by Chas. J. Bogue, 213 Centre Street, New York.

A New Sturtevant Eight-Pole Motor.

The B. F. Sturtevant Company, of Boston, Mass., has just brought out a new type of eight-pole motor, a cut of which is shown herewith. The field ring is of wrought iron, although in larger sizes it is made of cast-steel or cast-iron. The field cores are of wrought iron with a special type of cast-iron pole shoe, the peculiar size and shape of which renders the machine capable of extreme variation in load



8-POLE MOTOR.

without sparking or adjustment of the brushes. Machine wound field coils are used, and the shape is such that the windings present the greatest amount of radiating surface, so that perfect ventilation results. This type of motor was designed for direct attachment to a fan shaft. It has comparatively low speed, but high efficiency, and therefore special care has been taken in the design of the armature. The coils are built up of laminated, slotted discs. These discs are solidly clamped between two brass rings, having teeth to correspond

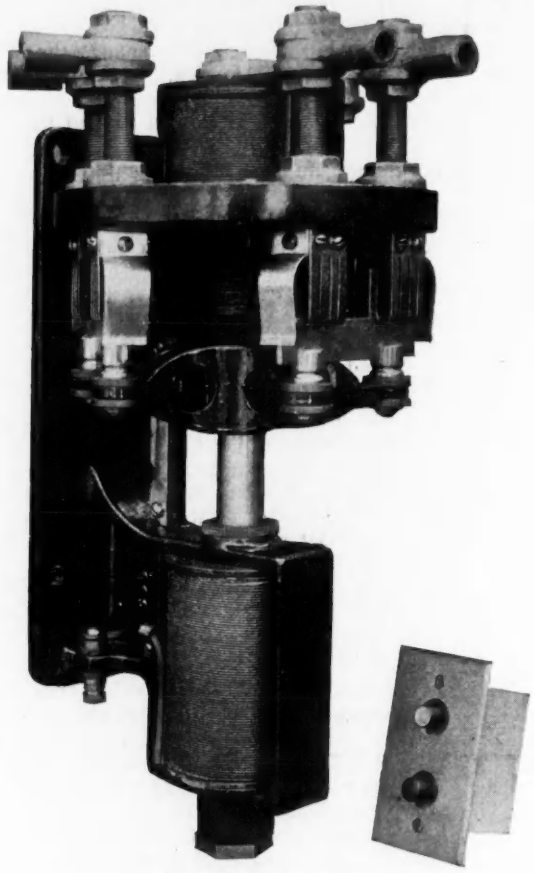
with the core teeth which support them at both edges of the core. The teeth are not only protected in this manner, but a smooth and well rounded corner is presented for the support of the slot insulation.

A commutator of large diameter is employed, with pure drop forged copper segmets. Carbon brushes with self-adjusting and self-feeding holders are used. A tripod support upon each side carries the ring oiler bearings. These motors are built in sizes from 3-hp up to 137.5-hp.

G. I. Automatic Switch.

The switch illustrated herewith is designed to control any number of electric lights or motors, etc., from one or a number of distant points, without running the heavy mains to the point of operation. Essentially it consists of a pair of solenoids held firmly in an iron frame, which acts as a return path for the magnetic lines of force and thereby greatly increases the "pull" during the time of opening or closing of the switch. As the switch begins to move the pull continually increases in strength until it reaches its maximum at the end of the stroke. This feature is very essential in closing the switch as the magnetism has to overcome the friction of the contacts and any hesitancy on the part of the switch to continue its motion at this moment would produce excessive arcing and pitting, thereby further preventing the switch blades from entering the clips.

The lower core has a lost motion which is first taken up by the solenoid producing a sudden and severe hammer blow which opens the contacts and is followed by the strong accelerating pull of the magnet until the final position is reached. There is no danger,



AUTOMATIC SWITCH.

therefore, of the switch stopping or even hesitating after it has once started to close or open.

The contacts are made very flexible so that there is no possibility of their sticking; they are also self-adjusting and make a flat rubbing surface. The current is broken in two places on each pole, making six breaks in a three-pole switch.

The illustration shows a 100-ampere three-wire switch such as is used on the Edison three-wire system, but single, double and triple pole switches are also manufactured for any capacity, voltage or system. There are provided arc catchers on each one of the contacts, so that whatever arcing occurs, in operation, will be taken up by them, and the contacts will not be burned or their temper reduced, no matter how often the switch is operated.

As the solenoids can be wound for any voltage, batteries may be used to operate the switch if it is not desirable to use the lighting circuit for that purpose. This method is often employed when it is desired to cut the lighting or power service entirely out of the building at night. The push button switch is made in a very substantial manner and will fit into any flush receptacle. The buttons, one black and one white, enable the operator to tell at a glance which to press in order to open or close the switch.

This switch is manufactured by the General Incandescent Arc Light Company, of New York.

Jewell Standard Instruments.

The accompanying illustration represents one of the types of direct current instruments manufactured by the Jewell Electrical Instrument Company, of Chicago, Ill. This line of instruments comprises ammeters, milliammeters, voltmeters and milli-voltmeters made up in the switchboard, portable and laboratory styles. The portable instruments are put up in a neat hardwood carrying case in size 6¾ x 6¾ x 3¾, and are so constructed as to withstand the rough usage to which portable instruments are frequently put. Their bases are of hard rubber. The switchboard instruments have a similar movement to the portables, set up in a cast-iron case suitably finished in brass, nickel or japan, and which acts as a magnetic shield. These instruments have rear connections and the voltmeters have an adjustable "normal index;" in size they are 10 inches in diameter. The Jewell standard instruments are all of the D'Arsonval type, having a coil moving in the field of a permanent magnet. The permanent magnets are made from imported magnet steel, and are thoroughly aged before being placed in the instrument. The springs are made from a special low resistance phosphor-bronze alloy having a fine temper. The series coils in the voltmeters and the shunts in the ammeters are made from an alloy having an o temperature coefficient. The voltmeters have a resistance of about 120 ohms per volt of scale, i. e., a 0—150 voltmeter has a resistance of 18,000 ohms.

The special features of this instrument, as pointed out by the manufacturers, are rigidity of construction, dead-beat qualities, constant temperature coefficient of the instrument, being unaffected by

TYPE OF JEWELL INSTRUMENT.

changes in temperature, hand drawn scales from recognized standards, which insure correct readings, scale divisions are uniformly spaced, no magnetic lag, since there is no iron in the moving parts, scale readings begin at 0, small amount of energy consumed by the meter—a 150 voltmeter consuming but 1¼ watts on the full deflection—fair accuracy of the instruments in all positions and absolute accuracy in the position in which they are calibrated whether vertical or horizontal, a device for eliminating the effects due to static electricity, and finally the adjustable scale operated by a small milled head partially projecting through the case and which on being turned by a rub of the finger operates a micrometer screw which in turn shifts the entire scale bringing the 0 of the scale to the 0 position of the needle should the needle become bent by any mishap.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET has had a special interest for electrical folk in the collapse of Third Avenue Railroad, which actually reached 45½, or about 200 below its quotation of a year ago. Why such things should be, Receiver Grant may be able to explain, but it is going to take a whole posse of bankers to pull that system out of the slough into which mismanagement or worse has plunged it. In its perpetual franchise the road has a valuable asset, and if well administered it should pay its way, but it has few possibilities of growth except in the annexed district. It was only natural that other street railway securities should move sympathetically, but with the storm over they should advance. During the week, Western Union gave another exhibition of its persistent weakness and on sales of 27,480 shares, declined to 82, a loss for the week of 1½. On sales of 1800 shares, General Electric was off 2 to 125. Metropolitan Street Railway went off 5½ to 168½, Manhattan Elevated 1⅝ to 94⅜. There were large dealings in Brooklyn Rapid Transit, and on sales of 246,170 shares, it declined 2⅛ to 67⅝. In Boston, American Bell Telephone was down to 318-319; Erie 109½-111; New England, 130-135; Michigan, 100 bid; Mexican, 2⅝-2¾; West End, 93¼ common, 111 preferred; Boston Elevated, 116¼; Massachusetts Elec. Rys., 77 pref. In Chicago, Metropolitan Elev. was quoted at 76 pref.; Shelby Tube at 18 common. In Philadelphia, Electric Storage Battery closed at 88-89 common, 96-97 pref.; Penn. Elec. Veh., 4-7 common, 3-3¼ pref. Am. Rys., 3½-3⅞; Elec. Co. of Am., 12⅜-12½; Phila. Elec., 5⅜-5½; Phila. Traction, 98½; Union Traction, 30½-30¾. In the New York outside market, Telegraph, Telephone & Cable Co., head of the independent telephone movement and purchaser of Erie, was quoted for the first time and closed the week at 4⅝-5. Consol. Elec. Ltg. & Equip. closed at 12½; Elec. Boat, 12-16 common, 35 pref.; Elec. Vehicle, 37-44 common, 75 pref. St. Louis Street Rys., 27 common, 80 pref.

METROPOLITAN STREET RAILWAY earnings show, as usual, a marked gain for the month over last February, and the company is encouraged to go right ahead with new work. President H. H. Vreeland has submitted a special report to the Executive Committee of the Board of Directors concerning the contemplated improvements in the construction and operation of the company's lines during the present year. The improvements will cost between $8,000,000 and $10,000,000. Among the most important changes will be the substitution of electricity for cable on Broadway, Columbus avenue and Lexington avenue. Electricity will also be installed in place of horse power on the line between Sixth avenue and Eighth avenue and the Christopher street ferry. The present "gap" in Broadway, between Fifty-ninth street and Sixty-fifth street, will also be completed. Another change will be the substitution of the underground electric system for the overhead trolley in 135th street, between Eighth avenue and Madison avenue. The road belongs to the Union Railway Company, but has been leased by the Metropolitan Company. A crosstown line will also be built in 145th street, from Lenox avenue to Broadway, and from 130th street in Broadway to 175th street. This all means large purchases of electrical material, supplies, etc., and a marked development of traffic. The total earnings for February were $1,043,980, a gain over the same month in 1899 of $213,470.

COMMERCIAL CABLE.—The annual meeting of the Commercial Cable Company was held at the Postal Telegraph Building on March 5. George G. Ward presided. The report of the board of directors for the year ending December 31, 1899, was presented and adopted unanimously. The report stated that the net trafic earnings from cables and land lines had increased $319,097.96 over the previous year. Out of the balance to the credit of revenue account there had been set aside $350,000 as an addition to the reserve fund and $150,000 to the fund for insurance of stations, apparatus and repair steamer. The reserve fund amounted to $3,475,631.05 and the insurance fund to $356,419.00. After providing for all operating expenses and reserves, the balance of net revenue, including the amount brought forward from the previous year, amounted to $1,748,063.26, out of which have been paid interest on the bonds and debenture stock ($720,000) and dividends and bonus on the capital stock ($800,000), leaving a balance of $228,063.26 to be carried forward to the present year. There have been added to the company's land system 1013 miles of poles, 13,253 miles of wire, and 118 new offices. The regular quarterly dividend of 1¾ per cent. is paid this week.

PITTSBURG TROLLEY DEAL.—Options of a sufficient number of shares of the Pittsburg & Castle Shannon to guarantee its merger with the West Side Belt Line Electric Railroad have been secured by Mr. Robert McA. Lloyd, representing New York financial interests. He has sent out notices to stockholders that the money is ready for them as soon as they conform with the necessary requirements. With the improvements that are to be made in the property the deal means a total outlay of $696,100. The company was organized 28 years ago, and has not paid a dividend for the last 12 years. The property consists of six miles of railroad, 512 acres of real estate and coal land, inclined plane and equipment. Mr. Lloyd will probably carry through his scheme this week.

NATIONAL CARBON.—The National Carbon Company has issued the following report for the fiscal year ending January 31: Net earnings, $451,687; addition to plants, $36,177; charged to depreciation, $63,149; accounts charged off, $1414; 7 per cent .dividends on preferred stock, $315,000; balance to profit and loss, $35,945; total, $451,687. Balance sheet Feb. 1, 1900, shows: Assets—Real estate, plant, etc., $9,300,000; merchandise, $368,600; cash, $213,213; bills and accounts receivable, $308,609; total, $10,190,424. Liabilities—Preferred stock, $4,500,000; common stock, $5,500,000; Div. payable March 15, $78,750; accounts payable, $75,729; profit and loss, $35,945; total, $10,190,424.

TELEPHONE DEALS.—Six Philadelphia ordinances, repealing telephone privileges granted to as many companies in that city, have been passed by both branches of councils with but little opposition, and this action is regarded as the first step toward the entrance into Philadelphia of the new big telephone company, the Telephone, Telegraph & Cable Company, of America. This company has acquired 51 per cent., or a controlling interest, in the Home Telephone Electric Company, which is to form a part of the trunk line system from the Atlantic seaboard by way of Pittsburg through the Middle West to tap the system acquired by the purchase of the Erie stock.

WASHINGTON TRACTION.—A special despatch from Washinton says: The Washington Traction & Electric Syndicate has offered $100 per share for a controlling interest in the Capital Traction Company, the only street car line in Washington outside the syndicate. The company is capitalized at $12,000,000. The present owners are holding out for a higher price, but it is thought an agreement will be soon reached whereby the property will pass to the control of the syndicate. A year ago, when the other lines of the city were absorbed by the syndicate, an offer of $90 per share was made for the Capital Traction stock, but the offer was declined.

LONG ISLAND LIGHTING DEAL.—The Queens Borough Electric Light & Power Company has passed into the control of the New York Gas & Electric Light, Heat & Power Company. The change was consummated last week by Anthony N. Brady, who secured control of $250,000 first mortgage 5 per cent. bonds and $250,000 in stock. The company controls valuable franchises and an extensive modern plant in Far Rockaway, L. I. It is now under contract with the city to furnish electric lights in Lawrence, Cedarhurst, Rockaway Beach and other districts in Queens.

PENNSYLVANIA LIGHTING.—Newton Jackson, of Philadelphia, who has purchased the electric lighting plants at Bradford, Oil City, Franklin, Kennett Square, Colesville and Haverford, Pa., will transfer these companies, together with other properties acquired to the Consolidated Electric Company, with a capital of $1,500,000. The Consolidated Electric Company, it is expected, will soon be listed on the Philadelphia exchange.

COMMERCIAL CABLE.—Mr. J. W. Mackay has just given some of the employees of the Commercial Cable Company an opportunity to buy its stock at par, in lots of from one to three shares, the stock being registered, however, to prevent jobbing in it. As the price is 185-190 this is a handsome present to the employees who avail themselves of the chance.

MR. HUGH J. GRANT, ex-mayor of New York City, has been appointed receiver for the Third Avenue Railroad System, and is now trying to straighten out its tangled accounts. Most of the old officers have resigned. The grand jury is to make an investigation also. The stock during the present week has remained near 55.

HUDSON RIVER TELEPHONE.—The stockholders of the Hudson River (Bell) Telephone Company have decided to increase the company's capital from $2,000,000, consisting of 20,000 shares of the par value of $100 each, to $3,000,000, to consist of 30,000 shares of the par value of $100 each.

B. R. T.—One result of the grand jury inquiry into the malicious hammering down of Brooklyn Rapid Transit stock lately has been the arrest of A. R. Goslin, alias C. B. Williams, in Philadelphia, for conspiracy. The jury report had not been made public early this week.

RAPID TRANSIT BONDS.—At the meeting of the board of estimate and apportionment of New York City on March 2 the issue of bonds for $36,500,000 for the Rapid Transit Railway tunnel was authorized.

GENERAL ELECTRIC CO. has declared a regular quarterly dividend of 1½ per cent., payable April 14.

DIVIDEND.—The Philadelphia Traction directors declared a dividend of $2 per share, payable April 2.

Commercial Intelligence.

THE WEEK IN TRADE was an excellent one, although the sudden outburst of winter weather in northern sections of the country hindered distribution of goods. Up to the present time the reports of the railroads have been wonderfully good. For the second week in February 70 roads show increased earnings of 30.19 per cent. over 1899, and for the third week 65 roads have reported an increase of 19.30 per cent. Dun's notes that the volume of business shown by payments through banks falls behind last year's wonderful record, even outside this city, where the daily average has been 10.4 per cent. smaller for February. Last year's financial arrangements for industrial combinations probably swelled bank clearings by several hundred millions. But the great expansion of loans this year is in part explained by such operations as the loan of $30,000,000 to the Russian Government, the whole amount being spent here for rails, rolling stock, and for war vessels. Considering the amount of missionary work done in the interest of lower prices, Bradstreet's thinks that iron and steel retain remarkable strength. Demand, as a whole, is of a hand-to-mouth character, though the February business at Pittsburg in pig iron is reported to have been heavy, with full quotations generally received. Strength abroad is still a feature, and considerable export business is reported to have been closed. Structural material is apparently in good demand. Failures in the United States for the month of February numbered 745, with aggregate liabilities of $9,995,464, a decrease of 3.5 per cent. in number from February a year ago. Liabilities are 3 per cent. heavier, but assets are considerably smaller than in the same period a year ago. Failures were more numerous in the middle states and in the northwest, but were fewer in New England, the central west, the south and the far west. Business failures for the week number 173, against 168 last week, 170 in this week a year ago, 232 in 1898, 262 in 1897 and 270 in 1896. The metal market was firm. Copper Lake ingot closed at 16¼ cents, tin at 31½ cents, lead at 4.70, and steel rail at $35 per ton.

BANKRUPTCY LAW DECISION.—The United States Circuit Court of Appeals for the District of Indiana has just rendered an important decision under the bankruptcy law. The Columbus Electric Company, being a creditor for $14,000 of the Fort Wayne Electric Company, received on December 9 three notes for that indebtedness, payable in thirty, sixty and ninety days. The first note, maturing on January 11, payment of $2500 on account was made. At that time the debtor was insolvent, but the creditor did not know it. A few days afterward the Fort Wayne Electric Company was adjudged a bankrupt. The Columbus Electric Company thereupon tried to prove its claim for the balance of the indebtedness. It was contended on behalf of the objecting parties that inasmuch as it had received $2500 such payment was, in fact, a preference, and that under Section 57, Subdivision G, of the act, it would have to return this sum of money to the trustee before it could be allowed to prove the balance of its claim. The District Court of Indiana sustained this contention, and the proof of debt was barred out. The Circuit Court of Appeals affirmed this action, holding that, notwithstanding the other provisions of the bankruptcy act (Section 60, A and B) to the effect that a preference can not be recovered for the benefit of the estate unless it be shown that the creditor receiving the preference had reasonable cause to believe a preference was intended, nevertheless it only applied to an action brought by a trustee for the recovery of the property and moneys received by the creditor. In the language of the opinion, it is the fundamental principle of the bankruptcy law that equality is equity, and the creditor in this case to prove his claim must surrender the preference he has received. "Under this decision," says Lawyer A. Blumenstiel, "any and all payments made by insolvent debtors to their creditors within four months of the filing of a petition in bankruptcy will prevent such creditors from proving the balance of their claim unless they return the payments received during that period. Merchants in all cases must receive payments during the period mentioned subject to losing the balance of their claim or of not sharing in any dividend that may be declared on bankrupt estates. Such a result will paralyze business transactions that are done upon credit. It calls for an immediate amendment of the bankrupt law in that respect if not for an entire repeal of the act."

NATIONAL AUTOMOBILE & ELECTRIC COMPANY.—Some details were given two weeks ago as to the formation of a new automobile company at Indianapolis by Mr. L. S. Dow and his friends. Articles of incorporation of the National Automobile & Electric Company have now been filed in Indiana. They relate that the purpose of the organization is to make, buy and deal in all kinds of self-propelling vehicles. The capitalization is $250,000, of which $100,000 is in preferred stock. L. S. Dow, Albert E. Metzger, Arthur C. Newby, Philip Goetz, Charles E. Test, Robert Martindale and H. T. Hearsey are named as incorporators. Mr. Dow, who will be president and general manager of the company, states that ground for a factory has been purchased on the south side of Twenty-second street, Indianapolis, at the junction of the Lake Erie & Western Railroad and the Belt. There are two and three-quarter acres in the site, which, Mr. Dow said, would be ample for present needs. Their purchase extends 320 feet east from the railroad and thence south 550 feet, the curve in the Belt forming the other boundary. The main building will be 350 feet long, 75 feet wide, with two stories. Clarence Martindale, architect, is now at work on the plans, and he expects to have them finished by this week, when the contract for the construction will be let. Mr. Dow said that the work is to be completed within ninety days. About 200 high class mechanics will be employed. The new company will make eight or ten designs of electric automobiles, all light and designed more for pleasure vehicles than heavy use. It will at first make only electric automobiles, but will be in position to put out rigs with other motive power if they are found to be practicable. Other electrical goods will probably also be made. The factory, according to the plans, will be completely modern in every respect. The windows will be large and the place flooded with daylight. There will be no interior partitions. Power will be distributed from a central power house and separate motors will run the heavy machines. Within the present week temporary quarters will be arranged and draughtsmen will begin work on the models of parts for the electric vehicles. Mr. Dow has resigned his position as manager of the Indiana bicycle plant and J. S. Conwell has succeeded him. C. F. Smith, former president and manager after the first formation of the trust, resigned, several months ago.

"UNIFORM TERMS."—Taking up this question, which has recently been discussed in this department, the "Iron Age" says editorially: "Manufacturers show an increasing disposition to put their business on a cash basis. For years comparatively few of them were able to insist on short terms of payment, partly because of the widespread financial stringency and partly because of the excessive competition for business, which brought about all kinds of concessions to customers. As has already been pointed out in these columns, the great increase in the demand for manufactured products has afforded an opportunity for introducing reforms in business methods, while the advent of numerous industrial consolidations has supplied the power to put them in force, one of the most notable of the changes thus brought about being in terms upon which iron and hardware are sold, there being a tendency among manufacturers to adhere strictly to net 30-day terms, without discount for cash. The jobbing hardware trade have not been disposed to regard this change with favor, as the withdrawal of the cash discount has been to that extent an advance in their costs, which must obviously be covered either by an advance in their selling prices or in a similar change of terms to their customers. As long as the manufacturers sold goods to jobbers on 60 days' time, with 2 per cent. cash in ten days, the jobbers were in a position to make the same terms to their trade, but to continue to grant them to their customers, at the same time paying cash to manufacturers, imposes something of a hardship on the jobbers."

EXPORTS OF ELECTRICAL MATERIAL.—The following were the exports of electrical material, from the port of New York, during the week ended March 3: Argentine Republic—100 packages electrical material $16,668; 290 packages electrical machinery $11,657. Alexandria—1 case electrical material $48. Brussels—1 case electrical material $71. British East Indies—83 cases electrical material $11,384. Bremen—1 case electrical material $42. Brazil—43 cases electrical material $1743. British Possessions in Africa—5 cases electrical material $313. Chili—2 cases electrical machinery $56; 3 cases electrical material $183. Cuba—29 cases electrical material, $859. Ecuador—3 cases electrical material $14. Hamburg—92 cases electrical material $2253. Hull—42 cases electrical material $160. Havre—339 cases electrical material $11,582. Liverpool—224 cases electrical material $10,157. London—58 cases electrical material $2099. Manchester—13 cases electrical machinery $3000. Nova Scotia—2 cases electrical material $48. Odessa—5 cases elec-

trical material $525. Peru—104 cases electrical material $1849. Stettin—64 cases electrical machinery $13,241. St. Helen's—191 cases electrical material $2500. U. S. Colombia—35 cases electrical material $541. Venezuela—52 cases electrical material $109.

STUDYING EASTERN TRADE.—An Oriental commercial museum has lately been opened in Berlin for the double purpose of establishing a permanent exposition of samples, on the plan of the Philadelphia Commercial Museum, and of acting as a chamber of commerce in facilitating trade between Germany and the Orient. A complete library and reading room, containing literature and newspapers from the Orient, are at the disposal of merchants, manufacturers and others. A bureau of information is also attached to give instruction and reliable information about business, firms and the peculiar conditions of various lines of trade in the Orient. The work of this bureau is to constantly watch the markets of the different eastern countries, and gather and study the confidential reports which are sent in by its staff of merchants and paid correspondents located in those countries. This new enterprise publishes a paper which transmits the latest and most important news from the bureau's correspondents. Another publication, issued periodically, has for object to foster trade relations and bring about closer connections with the people and governments of Oriental sections. Great expectations are entertained by German governmental and commercial circles as to the benefits which will accrue.

APARTMENTS AND AUTOMOBILES.—A well-known architect and builder, Mr. Wm. B. Franke, has begun to build a new apartment structure on the northwest corner of Seventy-ninth street and West End Avenue, New York City. It will have many new features of great interest to real estate owners, architects, builders and tenants. One of the chief new attractions will be the arrangements for automobiles. An open space of twenty feet in the rear of the lot will be occupied by a three-story extension. Its cellar will contain coal vaults, boilers and machinery, thus avoiding noise and vibration in the main building. The first story is designed for storage of eight automobiles, with room in the rear for storage batteries. The second story will contain four rooms for men servants and accommodation for seven automobiles, which will be lifted by an elevator. The automobiles may be charged with electricity on the premises and can be made ready for use at proper notice. Mr. Franke also proposes to supply electric carriages of different styles for use of tenants at reasonable rates. The building will be ready for occupancy in the fall. It will be known as the Century.

THE MAYER & ENGLUND COMPANY, of Philadelphia, has the contract for supplying all the rail bonds required for the Albany & Hudson Railway & Power Company, Hudson, N. Y., which company is building a high speed electric road with the third rail contact system. The bond order covers 21,000 extra heavy protected bonds to be placed under the joint plates of the wheel rails and 15,000 special 425,000 C. M. protected bonds for the contact rail. These latter types of bonds are to be applied to the foot of the contact rail with the special hydraulic bonding tools perfected by the Mayer & Englund Company. This hydraulic tool outfit consists of a punch, which cuts an upward tapering hole through the foot of the rail, and an hydraulic compressor which compresses the bond terminals backwards against the taper in the hole under a pressure of thirty-five tons. Mr. Maurice Hoopes, the general manager of the railway company, awarded this order to the Mayer & Englund Company, after a most thorough investigation of the subject. The entire order aggregates $20,000, and is believed to be one of the largest ever placed for rail bonds.

UNIFORM RATES.—We have received the following important letter from Mr. J. G. Hickcox, the secretary and treasurer of the Cutler-Hammer Manufacturing Company, of Milwaukee. We shall be glad to co-operate in any work tending to secure the desired result, but it seems to us that action by the trade credit associations is the most practical step to take. Mr. Hickcox says in his letter:

"We note your article in regard to uniform terms of payment, and we think the question is an important one, and one on which some definite action should be taken by the electrical trade. Would it not be a good idea to print in your paper the following card with the request that it be filled out and forwarded to you? 'We are in favor of uniform terms of payment, and think ..... days, with ..... discount for cash in ..... days would be the most desirable.' We think the electrical trade would be very glad to adopt the terms which seemed to be most in favor, and see that they were adhered to. If you would do this we think the whole electrical trade would be indebted to you, and we beg to extend our thanks in anticipation."

THE UNITED STATES CARBON COMPANY, of Cleveland, Ohio, said to be the only arc light carbon manufacturers in the United States outside the "Carbon Trust," had their works partially destroyed by a fire on November 19. They have rebuilt, installing new machinery, and have also added two large brick factory buildings, which are now in complete running order, thus greatly increasing their capacity. The plating department, which was completely destroyed by the fire, is temporarily replaced and is now in operation at its full capacity. They are also installing new plating machines, of the latest and most efficient type, to be in operation by May 1. Thus they will be thoroughly able to take care of all customers requiring copper coated carbons during the coming year. They report business growing, and say that their carbons have met with wonderful success in the market. They are now arranging for another large increase to their plant, for which they have the plans prepared, and expect to begin work early in the spring.

LEAGUE OF CONTRACTORS.—With regard to the strained relations between electrical supply concerns and electrical contractors noted in this department last week the following special despatch from Pittsburg, of March 3, will be of interest: "A call for a convention of all the electrical contractors in the United States, to be held in this city on March 16, has been issued by the Pittsburg Electrical Contractors' Association. The object of the convention is to take some defensive action consequent upon the combination of electrical supply houses and the probable advancing of prices on material. There are in the United States more than 4000 electrical contractors who are rated by the mercantile agencies at $20,000 and over. Fully 1000 of these are expected to attend the convention to be held here, and an effort is to be made to form a national organization."

EXPORTS TO SOUTH AFRICA.—The cessation of hostilities in South Africa, or apparently even the success of the British arms in opening up country now closed or devastated, makes it necessary to be keen for opportunities in that field. Mr. J. G. Stowe, United States consul-general at Cape Town, writes under date of December 25: Tenders for bridge work, electrical and railway material, and machinery are open for bids. Large shipments of fire extinguishing apparatus from London are arriving, on war account, for hand engines and to put out fire caused by shells. East London has recently built an electric light plant and an electric tramway, using Babcock & Wilcox boilers and other American appliances. The imports of electrical materials for October exceeded the corresponding month of 1898 by $30,000.

ELECTRIC ELEVATOR FOR WASHINGTON MONUMENT.—Since the completion of the Washington monument 1,789,688 persons have been to the top of the structure, most of them by means of the steam elevator that was used, even before visitors were admitted, to carry materials to the workmen. The engine at the monument is reported by Colonel Bingham to be nearly worn out with incessant day work since 1888. The engine and elevator are perfectly safe, but Colonel Bingham says he wants $26,000 to spend in providing an electric elevator. Not long ago the steam engine was found to be leaky, and a stop for about two weeks was necessary to put it in repair. Congress will be asked to make the necessary appropriation. The lift is 500 feet.

CROCKER-WHEELER CO. report that they have just closed a contract with the St. Louis Refrigerating & Cold Storage Co., of St. Louis, Mo., for two No. 224 generators of 200-kw at 500 volts, and 38 motors ranging in size from 1-hp to 35-hp; also two special double field motor dynamos. They have also just closed a contract with the Dow Chemical Co., of Midland, Mich., for a 475-kw generator to furnish current at 300 volts for electrolytic work. The Crocker-Wheeler Co. are making a specialty of large machines intended for use in the new and important electrolytic industries.

YORK MFG. CO., York, Pa., are furnishing a 30-ton ice-making plant, on the can system, to Samuel Berryman's Sons, Philadelphia, Pa. The Washington (Pa.) brewery has ordered a 20-ton refrigerating plant and W. W. Motz, Lincolnton, N. C., will put up a York 6-ton plant. Mr. M. Seitz, of Brooklyn, N. Y., has given a contract also to the York Company for removing the double-acting compressors on the refrigerating machines in his brewery and replacing them with single acting compressors of the latest improved York style.

THE ELECTRIC LEAD REDUCTION COMPANY, of Niagara Falls, has placed orders for machinery that will enable it to increase its output 1000 per cent. This order has been placed with the Westinghouse Company. At present the Electric Lead Reduction Company is turning out about one ton of spongy lead per day, and the new machinery will enable it to turn out ten tons a day. The number of hands employed will be materially increased. The plant is located on the lands of the Niagara Falls Power Company.

THE PENN STATE CONSTRUCTION CO., of Philadelphia, has made a contract with the Merchants' Light, Heat & Power Co., of Youngstown, O., to build and equip a light plant. The building to be erected on South Hazel street, Youngstown, work to be commenced at once and completed by May 15.

GRAPHITE FOR ENGINE CYLINDERS.—The Chicago Edison Company are using Dixon's Ticonderoga flake graphite now in all their engine cylinders, and have equipped the engines with hand pumps for putting in the graphite. They are thoroughly satisfied with the results.

Special Correspondence.

FOREIGN NOTES.

London Office, ELECTRICAL WORLD AND ENGINEER, Feb. 24, 1900.

WARRINGTON LIGHTING.—The Local Government Board has complied with the application of the Corporation of Warrington for sanction to borrow the sum of £44,966 for the purposes of electric lighting, and to a further sum of £9,336 for the provision of a central depot at Parr Street, at which refuse destructors are to be erected.

KIDDERMINSTER will ere long enjoy the benefits of electric lighting, which it has not as yet had in a general way, though there have been a few private installations in the city. The Corporation obtained an electric lighting order some years ago, but instead of themselves putting down an electric plant and equipment, they have disposed of their concession to the British Electric Traction Company, who have other interests in the town, and who are now installing a generating station at the electric tramway depot with which to furnish the current for the lighting of the town.

BLACKPOOL is again making application for power to borrow about £50,000 for increase in its electric lighting, so as to be able to keep up with the increasing demand. This is the fifth application for sanction to borrow money for electrical purposes made since 1893, since which time £120,000 has been borrowed. The consumers have increased in that time from 112 to 900, and in view of the increasing demand for electric lighting and also for power for the tramways, it was absolutely necessary that the works should be extended, and that more capital should be expended.

ALTERNATING CURRENT LITIGATION.—As foreshadowed in this correspondence the case of Martin D. Rücker versus the London Electric Supply Corporation, has utterly fallen through, and Justice Farwell has given his decision in favor of the defendants and Mr. Rücker has to bear the costs. It is needless to say that the decision has given universal satisfaction. The patent in question was filed in 1885. If the action had been successful it would have rendered all companies using alternating current liable to pay heavy royalties. Up to 1898 no attempt had been made to collect royalties, and it was found out that the patent was only acquired by Rücker in 1897, when it was refurbished and some strong claims added, which practically meant a patent for the system of using transformers in multiple arc. It appears like dipping into ancient history now, but it is gratifying to note that Justice Farwell clearly maintained that the distribution of currents in parallel, whether direct or alternating, was known prior to 1885.

THE HON. C. A. PARSONS recently delivered a most interesting lecture at a meeting of the Royal Institute on "Motive Power, High Speed and Turbines." As Mr. Parsons is devoting his time at present to the application of steam turbines for marine purposes, much of the lecture was taken up with the use of turbines for propelling ships, but some interesting points were also brought out regarding steam turbines and electric generators. Mr. Parsons said that with the general introduction of the dynamo the steam engine became a most important factor, and experiments in steam turbines were commenced about 1884. In 1888 several turbo-alternators were supplied, of about 120-hp, non-condensing, with a speed of 9000 or 10,000 revolutions per minute, and a steam consumption of about 35 pounds per electrical horse power. The radial-flow type of turbine made to work with condensers, was developed in 1892, from which date new records in steam economy may be dated. At present turbines of 2000-hp are being built, and a large turbo-alternator recently tested made a remarkable record by consuming only 18.8 pounds of steam, 10 degrees superheated, per kilowatt hour, when running at full load.

BRITISH TRADE RETURNS.—It may be interesting to know by actual figures at hand, from the January Trade Returns as to just what effect the war has been having on trade, though it is not possible, of course, to say what effect it may have had on individual cases, either in the way of decrease or increase of business. The totals were all increased over the corresponding month last year. Exports of yarns and textile fabrics have increased over a million sterling, metals and articles manufactured therefrom, except machinery and ships, just about a million, raw materials, three-quarters of a million, and other manufactured or partly manufactured articles about £300,000. Imports have also been increasing in about the same ratio. Raw materials by about a million, manufactured articles by a million, metals by nearly three-quarters of a million and dutiable articles of food and drink by £600,000. Exports of pig iron show a remarkable expansion, the total in weight being 130,246 tons, compared with 49,871 tons in January, 1899. The table subjoined will be interesting:

Exports for month	£23,583,682.
Increase in 1899	3,236,448.
Imports for month	44,560,849.
Increase	3,344,243.
Re-exports for month	5,482,465.
Increase	362,205.

METROPOLITAN UNDERGROUND TRACTION.—Lately there have been many comments made regarding the action of the Metropolitan and the Metropolitan District Railway Companies in carrying out a series of experiments, as to the advisability of adopting electricity as the motive power for these railways. These comments have been in the nature of criticisms of the policy of the Metropolitan Railway Company in, at this late day, thinking it necessary to conduct an elaborate series of experiments to arrive at conclusions which any electrical engineer could foretell, and it may be that we have ourselves spoken rather lightly of these same experiments. On further investigation, however, it appears that these experiments are being conducted for a very different purpose. The Metropolitan Railway Company knows, as well as the most enthusiastic engineer, that it is quite feasible to operate the road electrically; that is in evidence right in London, but what the railway company does want to know, is, "Can the system be changed from one of steam locomotive haulage, to one operated by electricity without in any way hindering the existing traffic, or in other words, without stopping the running of a single train." That is the vital question which they insist upon knowing, before deciding to embark upon a huge enterprise of this kind, and before even they go into the figures of economy of working, and the best system to adopt. It is for this reason, therefore, that a small power plant has been erected in the vicinity of Earl's Court Station, equipped with Bellis-Morcom engines and Siemens generators, which are capable of furnishing sufficient current at 500 volts to operate an electric train between Earl's Court Station and Kensington High Street. This short section of the underground system is now operated by a "shuttle" train, which runs backwards and forwards on that section only, but as soon as the necessary signals are arranged the electric train will be put in permanent service and a thorough and long test made for at least six months. Sir Wm. H. Preece and Sir J. Wolfe Barry have acted as engineers for this work, and are making exhausting research and investigation as to the various methods available for the conversion of the whole road when such a decision is arrived at. In the meantime it may be stated positively that the underground system in London will be worked electrically and that the directors of the Metropolitan and the Metropolitan District Railway Companies are in earnest. At present the experimental train is equipped with two motor cars, one at either end, the rear one being idle on each trip, and the current is conveyed to the motors by a pair of conductor rails formed of channel iron, which are laid along the present track and outside the rails, and a few inches above their level. When it comes to building a permanent station for the underground system, it is extremely probable that the three-phase system with sub-stations, equipped with rotary transformers, will be adopted, and the District Railway Company has already signified its intention of asking parliament for powers to build a generating station at Chelsea Creek, where there is abundant space and condensing water can be procured.

General News.

THE TELEPHONE.

ST. JO, TEX.—John Gibbs, of Arkansas, is putting in a local telephone exchange in this city.

PARADISE, ORE.—A project is on foot to connect Paradise, Ore., with Anatone, Wash., by telephone.

PEKIN, ILL.—The Central Telephone Company has refitted its entire plant at Pekin with new wires and instruments.

RICHMOND, VA.—A bill has been introduced in the legislature to incorporate the West Norfolk Telegraph & Telephone Company.

RICHMOND, VA.—The Spotsylvania Telephone Company will construct a telephone line from here to Fredericksburg, and also to Sunlight.

TOLEDO, OHIO.—The New Harrison Telephone Company has given a trust deed to the Security Trust Company to cover issue of $100,000 in bonds.

THE ERIE TELEPHONE SYSTEM made a net gain of 3094 subscribers in February. Total number connected Feb. 28, 113,327. Number waiting connection, 5580.

ALMA, MICH.—At a meeting of the Union Telephone Company the capital stock was increased from $25,000 to $100,000. A dividend of 8 per cent. was also declared.

DOVER, DEL.—The Gould Telephone Company, of Philadelphia, has been incorporated here to "manufacture and use telegraph, telephone and electric light products."

ELYRIA, OHIO.—The Elyria Southern Telephone & Toll Company has been formed with $20,000 capital. Incorporators: T. M. Brush, A. E. Lord, F. H. Sudro, J. H. Dake, I. H. Griswold.

DETROIT, MICH.—The Gratiot and Isabella Counties Independent Telephone system has secured a pool, representing 90 per cent. of the stock, as a precaution against a sale to the Erie Company.

BEVIS, OHIO.—The Colerain Telephone Company, of Bevis, has been incorporated with a capital of $999. Incorporators: S. A. Butterfield, I. S. Wyckoff, H. Shaw, D. A. Bevis, J. S. H. Potter.

BRIDGEPORT, OHIO.—The Belmont Telephone Company, of Bridgeport, has been incorporated with a capital of $15,000. Incorporators: J. D. Heinlein, J. B. Driggs, J. C. Dent, A. Heinlein, R. B. Mitchell.

ZANESVILLE, OHIO.—The Muskingum Valley Telephone Company, of Zanesville, has been incorporated. Capital, $10,000. Incorporators: R. L. Holland, J. R. Voll, H. Bethel, W. M. Bateman, J. Blankenbumer.

WATERLOO, IA.—The County Telephone and Telegraph system, of Waterloo, has been incorporated to do a telephone and telegraph business. Capital, $150,000. Incorporators: G. G. Bickley, G. E. Bickley, both of Waterloo.

HIAWATHA, KAN.—The Brown County Telephone Company has been organized in Hiawatha, Kan., with a capital stock of $20,000. C. W. Wellcome, president; Samuel Bierer, vice-president; C. D. Lamme, treasurer; F. M. Pearl, secretary.

EL PASO, TEX.—At a special session of the city council a franchise was granted to a second telephone company, which proposes to string wires and rent telephones at a lower rate than the Southwestern Company and run in opposition to it.

WORCESTER, MASS.—It is stated that several gentlemen of this city contemplate organizing a new telephone company. Some of those interested are Fred W. White, R. James Tatman, Charles H. Hildreth, Charles M. Thayer and R. F. Taylor.

LUTESVILLE, MO.—The Valley Telephone Company, of Lutesville, has been organized with a capital of $10,000. Incorporators: J. A. Berry, of Glen Allen; E. P. Biggs, W. Cook, C. O. Hobbs, all of Lutesville; Samuel J. McMinn, of Marble Hill.

ANTELOPE, ORE.—The Wasco Southern Telephone Company has been incorporated, principal place of business, Antelope, Ore., to build telephone

lines in Wasco County. Capital stock, $5000. Incorporators, J. N. Burgess, H. C. Rooper, F. N. Wallace.

DETROIT, MICH.—The Bell Telephone Company will place slot machines in all the hotels and public places in Windsor in order to prevent non-subscribers from using the lines to Detroit. A payment of 10 cents will be required for the use of the instrument.

AUSTIN, TEX.— An unsually large number of short telephone lines are in course of construction in Texas and Mexico. There is now hardly a town or village in Texas that is without telephone service and they are rapidly being connected with the long distance circuits.

LOCKPORT, N. Y.—The new system established here by the Bell Telephone Company, of Buffalo, of charging $1.50 per month for house telephones up to 30 messages, or one a day, and 5 cents extra for additional messages up to 60, strikes many as being no reduction at all.

RICHLAND CENTER, WIS.—The Union Telephone Company, which controls the city telephone lines in Richland, Grant, Crawford and Iowa counties, has made a proposition to the various farmers' lines in the counties to have the latter lines connect with the central stations of the Union Company.

JACKSON, MICH.—The Michigan Telephone Company, following the precedent established in Detroit, will install two classes of service in this city, one with the Blake transmitter at about the present rate, and an improved service at about $48 a year. Plans for enlarging and remodeling the exchange have been approved.

TROY, N. Y.—The Troy Telephone & Telegraph Company has elected the following directors: George P. Ide, Alga M. Ide, William S. Earl, James F. Cowee, Troy; W. C. Humstone, C. H. Erwin, Charles A. Tinker, Jeffries Wyman, New York; C. Jay French, Boston. Mr. Wyman succeeds Joseph P. Davis ,of New York.

BELLEVILLE, MICH.—The effect of the consolidation of the telephone companies is already being felt in this town. The Michigan Telephone Company has raised its rates for service from $12 to $18 a year for house instruments and for business houses from $18 to $24. These rates apply to all new contracts. The old contracts will remain in force.

SOUTH OMAHA, NEB.—The Western Independent Long Distance Telephone Company, Plattsmouth, Neb., have made application for a franchise in South Omaha for 25 years, for the prime purpose of putting up territorial lines and with the intention of building an exchange later. The company has 150 exchanges and stations in Nebraska, Iowa, Missouri and Kansas.

PORTAGE, WIS.—The managers of several telephone lines met recently and closed contracts with the Portage Telephone Company for a metallic circuit which will connect Janesville, Evansville, Milton Junction, Stoughton and all points west and south. A metallic circuit will also connect Portage and Baraboo. The Troy-Honey Creek telephone line will be extended to Lodi.

AUSTIN, TEX.—The Southwestern Telegraph & Telephone Company is to have competition in all the principal cities of Texas. Independent companies have already applied for franchises to establish telephone exchanges in San Antonio and Austin, and application is soon to be made for franchises in the cities of Fort Worth, Dallas and Galveston. Waco and Houston already have independent companies in operation.

OSHKOSH, WIS.—The Little Wolf River Telephone Company, which for the past year has secured exchange connections through the Northwestern Telephone Company, which was recently purchased by the Wisconsin Telephone Company, was notified March 1 that no more connections will be made. It is asserted that the Little Wolf River Company is preparing to start an exchange of its own in this city and will soon apply for a franchise.

OSHKOSH, WIS.—A resolution has been presented to the common council to force the Wisconsin Telephone Company to live up to the provisions of the franchises of the Northwestern Telephone Company, which the Wisconsin Company bought a few days ago. The Northwestern's franchise requires that the rate shall be $18 a year for residence instruments and $30 a year for business houses. The Wisconsin Company has no restrictious put upon it at present.

KANSAS CITY, MO.—The Missouri & Kansas Telephone Company is spreading a network of wires about the middle west and south. Two new lines have been ordered built in this section besides the ones already in course of construction. The company proposes to complete the gap between Arkansas City and Perry so that there will be a through line from this city to Purcell. Another line has been ordered built, which, when completed, will put Wichita in direct communication with Galveston, Tex., and all the principal towns in that state.

DOVER, DEL.—Harry A. Richardson, of Dover, who owned the telephone lines of Cecil county, has deeded all of these lines to the Eastern Shore Telephone Company. The Union Telephone Company, of Talbot county, has also deeded its lines in Dorchester and Talbot counties to the Eastern Shore Telephone Company. The Eastern Shore Telephone Company has executed a mortgage to William H. Deweese, as trustee, in the sum of $100,000 to secure bonds to that amount, the proceeds from the sale of which are to be used in building new telephone lines and improving the old ones owned by the company.

PITTSBURG, PA.—A triangular telephone war is expected to be one of the events of the coming spring in Pittsburg and Allegheny. The companies interested are the Central District and Printing Telegraph Company, which is the old Bell concern, and has the most subscribers, underground conduits and pole lines everywhere in this vicinity. The second concern is the Pittsburg & Allegheny Telephone Company, which is said to be controlled by Brown Bros., Baltimore bankers. The president is Henry A. Parr. This company has laid some underground conduits in the downtown part of Pittsburg. It claims to have about 5000 subscribers and promises to have its system in operation by April 1. The third is the Federal Telephone Company, of which Fred De Land is the active promoter. The latter claims to have franchises in all the surrounding towns and villages for a radius of 100 miles from Pittsburg. To complete this system the company now asks for franchises in the two cities. The peculiarly interesting feature about the two alleged independent companies is that the one accuses the other of being owned by the Bell Telephone Company.

ELECTRIC LIGHT AND POWER.

HASTINGS, NEB.—At a recent election here a majority vote was cast in favor of an electric light plant.

FULSHEAR, TEX.—H. E. Thompson will install an electric light plant here and is receiving estimates for the necessary machinery.

BRENHAM, TEX.—Mr. J. H. Saunders, formerly of Galveston, has been appointed manager of the electric light plant at this place.

RICHMOND, VA.—The legislature of Virginia has just appropriated $10,000 for erecting an electric light plant at the University of Virginia.

PERU, IND.—The City Council has authorized an issue of $40,000 worth of bonds, the amount to be expended in giving the city water and electric lights.

LITTLE ROCK, ARK.—The Consumers' Light & Power Company has surrendered its charter, the company having consolidated with the Edison Company.

MINNEAPOLIS, MINN.—The Minneapolis General Electric Company will erect a new station building in this city. It will include a storage battery plant.

CINCINNATI, OHIO.—The Cincinnati Edison Company will spend more money on its new uptown plant than was at first estimated. The accumulator plant alone will cost $130,000.

BIRMINGHAM, ALA.—The Consolidated Electric Light Company broke ground for a $200,000 light anu power plant which is to be a reproduction of the present plant and double its capacity.

PUEBLO, COL.—The New Mexico Light, Heat & Power Company has been incorporated. Capital, $30,000. Incorporators: E. S. Woods, F. L. Guddeback, H. E. Currie, all of Pueblo.

SAN MARCOS, TEX.—The San Marcos Electric Light & Power Company has passed into the hands of William Green and associates. The new owners will make a number of substantial improvements.

LUFKIN, TEX.—Extensive improvements are to be made in the electric light plant in this place. This plant was recently purchased by R. C. Adams and is under the management of L. L. Stevenson.

ALTON, ILL.—The Alton Electric Service Company has been incorporated to operate an electric and gas plant. Capital, $20,000. Incorporators: W. L. Waples, H. S. Graber, R. L. McLaren, all of Alton.

SCRANTON, PA.—The handsome new dining cars recently placed in service on the Lackawanna Railroad are completely lighted by electricity generated from the axle. The cars are ventilated by electric fans.

TEXCOCO, MEX.—A new electric light plant has just been inaugurated in this town. The event was celebrated with a grand ball which was attended by many distinguished officials and a great throng of townspeople.

MONTICELLO, N. Y.—The Murray Electric Light & Power Company, of Monticello, has been incorporated with a capital of $20,000. Directors: Peter C. Murray, Della Murray and Elmer S. Rockafeller, Monticello.

BLAINE, WASH., recently lost its city electric lighting plant by fire. Electrician W. L. Taulby lost his life in the fire. The entire property was owned by W. H. Walker and L. W. David. Loss, $30,000; insurance, $6000.

CLEVELAND, O.—Considerable electrical equipment and electric elevators will be required for a new power block to be erected in Cleveland by Michael Striebinger. Frederick W. Striebinger is the architect in charge.

CLEVELAND, O.—B. P. Foster, of Cleveland, has been awarded the contract for a municipal lighting plant at Lowellville, O. The contract calls for the furnishing of dynamos, engine, boiler, poles, lamps, wires, etc.

DALTON, GA.—The authorities have offered to purchase the plant of the Dalton Gas & Electric Light Company, for operation on municipal account, for the sum of $10,000. The owners of the company ask $16,200 for its properties.

IRAPUATO, MEXICO.—The new electric light plant in this city was inaugurated on February 23. The occasion was celebrated by festivities in which Gov. Gonzales Obregon and other distinguished State officials participated.

ANDERSON, IND.—A Chicago syndicate has made an offer for the city electric light plant, and an exclusive franchise. The offer was $150,000, or near that figure. The city declined the proposition because the franchise was included.

CALDWELL, TEX.—The City Council of Caldwell, Tex., has granted a franchise to J. B. McGee, of Bonham, for an electric light plant and telephone system in that place. The work of establishing these improvements will begin at once.

WILDWOOD, N. J.—The Five-Mile Beach Light, Heat & Power Company, of Wildwood, has been incorporated with a capital of $100,000. Incorporators: H. H. Ottens, of Wildwood; S. W. Fleming, G. Moffat, both of Philadelphia, Pa.; H. S. Douglass, attorney.

SAN FRANCISCO, CAL.—The San Francisco *Examiner* recently closed down its steam and electric plants, which are very efficient, and now purchases electricity for lighting and power purposes, and also steam from the San Francisco Gas & Electric Company.

SAN FRANCISCO, CAL.—The finance committee of the San Francisco Board of Supervisors has recommended the abolition of street lighting from March 1 until July 1, as the only feasible way of reducing the city's expenses to prevent a deficit and preserve its credit.

WILLIAMSON, MINGO COUNTY, W. VA., is to have electric lights and a system of water works, a charter for that purpose having been issued. The capital is $10,000 and the company has the privilege of increasing to $50,000. The incorporators are citizens of Williamson.

PITTSBURG, PA.—The Pennsylvania Railroad Company is introducing electric motors at a number of roundhouses between this city and Altoona to oper-

ate the turntables, and from the experiments they have already made it is expected that the plan will be entirely successful.

ST. LOUIS, MO.—H. R. Buad, of Bunker Hill, Ill., the lowest bidder on the city electric light contract in the district east of Jefferson Avenue, was awarded the contract on February 24. His bid was $11.60 per 1000 arc lamp hours and $2.35 per 1000 incandescent lamp hours.

MORGENTOWN, W. VA.—The executive board of the penitentiary have decided to establish an electric light plant at that institution to supply their own lights. Mr. John P. Cilley, an electrician, has been employed to determine exactly what is needed and to ask bids for the necessary machinery.

EDGEWATER PARK, N. J.—The Electric Light, Heat & Power Company, of Hammonton, Edgewater Park, has been incorporated with a capital of $25,000. Incorporators: F. J. Thorn, of Edgewater Park; G. E. Brett, of Philadelphia; C. C. Gallagher, of Beverly; F. J. Thorn, attorney, Edgewater Park.

McMINNVILLE, ORE., will have a new dynamo and apparatus for arc lights. The General Electric Company closed the contract, notwithstanding the fact that doubts had been thrown upon the validity of a contract with the City Council. There had been trouble over a city election, and for a time there were two sets of councilmen.

MINEOLA, L. I.—The board of supervisors granted permission to the Roslyn Light & Power Company to erect poles and wires, lay pipes or other conductors on the county roads within the towns of North Hempstead and Oyster Bay for the purpose of supplying the inhabitants of those towns with electricity for light, heat and power.

SAN FRANCISCO, CAL.—The San Francisco supervisors' committee on public utilities recently decided to begin making inquiries into the cost of installing plants for carrying on public utilities. The subjects of investigation will be the cost of gas and electric lighting plants, street railways, a telephone system and the Spring Valley Water Company's plant.

NEW YORK, N. Y.—At a meeting of the stockholders of the Edison Electric Illuminating Company, of Brooklyn, the following directors were elected: Anthony N. Brady, William Berri, Charles Cooper, Horace Du Val, Walton Ferguson, Bernard Gallagher, Hugh J. Grant, Seth L. Keeney, Thomas E. Murray, R. C. Peabody, W. F. Sheehan, T. S. Williams and A. M. Young.

JOHNSTOWN, PA.—The Cambria Iron & Steel Company, of Johnstown, Pa., has installed four 400-kw electric generators to furnish electric light and power throughout the mills. Motors have been adopted to operate the turntables in the rolling mills and all the cranes are being equipped with electric motors. The Westinghouse Electric & Manufacturing Company has furnished the electrical apparatus.

POMEROY, OHIO.—The city council has contracted with The Pomeroy & Middleport Electric Company, for a period of 10 years, for street lighting with 35 enclosed arcs and eight incandescent lamps. The new arrangement is to go into effect July 1. The company is considering the remodeling of its plant. E. S. Trussell is the general manager.

ALBANY, N. Y.—Certificates of merger of the Manhattan Electric Light Company, capital $1,500,000, and the Harlem Lighting Company, capital $250,000, with the Edison Electric Illuminating Company of New York, were filed March 1 with the secretary of state. The Edison Company was itself some time ago practically absorbed by the New York Gas & Electric Light, Heat & Power Company, which latter corporation is now under the control of the Consolidated Gas Company interests.

ALBANY, N. Y.—The United Gas & Electric Company, of Syracuse, was incorporated with a capital of $4,000,000, to manufacture gas and electricity. The capital stock is divided into $1,000,000 preferred and $3,000,000 common stock. The directors are: L. Bedell Grant and John T. Kirk, of Brooklyn, and Ashley T. Cole, of New York City. The company takes over the business of the present Syracuse Electric Light and Syracuse Gas Companies, and its operations will extend throughout Onondaga County.

SHASTA, CAL.—The Mount Shasta Light & Power Company, incorporated, is about to begin construction work on its electric transmission system. Estimates have been received for the electrical apparatus and the work will be speedily completed. It will be a three-phase transmission with several lines of varying length. The line to Red Bluff, Cal., will be forty miles in length. The plant, which will be located on the McCloud River, will also transmit current to Redding and Shasta. Electric power will be furnished to supply the needs of the Delamar group of mines and those of the North California Investment Company. The Mountain Copper Company, operating mines and the smelters at Keswick, will be a heavy consumer of power. The capacity of the electric plant will be 5000-hp, and induction motors will be used on the distributing lines. The head of water is 300 feet. Air blast transformers will be used throughout. This was decided after careful consideration of the fire risks attending oil-cooled transformers. Sidney Sprout is consulting and construction engineer.

PITTSBURG, PA.—There is a plan on foot here to consolidate all the electric light and power interests in Allegheny County, and from the preliminary steps that have already been taken the project bids fair to be soon realized. There are now three large companies in this county. The Allegheny County Light Company controls the electric light and power business of the city of Pittsburg proper, the Monongahela Electric Light & Power Company, which controls all the small plants in the boroughs and towns east of the city and adjacent to the Monongahela River, and the Southern Light & Power Company, which controls all the plants in the smaller towns south of the Ohio River. This leaves the plants in the north and west to be yet secured. For this purpose the Northwestern Electric Light & Power Company has now asked for and received a charter in Harrisburg. Among the more important companies which will be taken into this combination are the Sewickley Electric Light Company and the Ohio Valley Electric Light Company. It is understood that when the negotiations are completed one large power house will be built and all the electric current will be furnished from one station.

THE ELECTRIC RAILWAY.

INDIANAPOLIS, IND.—At the Populist convention a resolution was passed in favor of municipal street car lines.

INDIANAPOLIS, IND.—There is public agitation here in favor of paying 3 cents fare on street railways when no seats are available.

OXFORD, MICH.—The Orion village council has granted a franchise to Winters & Lau and work on the new electric road has begun.

CITY OF MEXICO, MEXICO.—It is proposed to convert all of the horse-car lines in this city into electric lines as rapidly as possible.

VERSAILLES, IND.—An election will be held on March 27 to vote a subsidy for the proposed electric railway between this city and Osgood.

RICHMOND, IND.—Henry B. Pruden, of Dayton, O., has been granted a franchise for an electric railway from this city to the Indiana-Ohio State line.

HOUSTON, TEX.—The Houston Electric Street Railway Company has filed a suit to enjoin the enforcement of an ordinance recently passed compelling it to give transfers.

BENNINGTON, VT.—Work on the new power station of the Bennington & Hoosick Valley Electric Railway Company will be commenced as soon as the weather will permit.

FORT WORTH, TEX.—The survey for the proposed electric railway between this city and Dallas has been commenced. The distance between the two towns is thirty miles.

ROME, N. Y.—The Rome City Street Railway Company is preparing to make an extension of about three miles in its present system as soon as the frost is out of the ground.

KANAWHA, W. VA.—Charter was granted the Kanawha Traction & Electric Company to build an electric railway from Kanawha Falls to Coalburg, a mining town. Capital, $100,000.

UPTON, MASS.—The selectmen of Upton have appointed March 7 as the day for a hearing on the petition of the directors of the Milford, Grafton & Upton Street Railway Company.

FRANKLIN, PA.—The trolley line from DuBois to Franklin will take in DuBois, Reynoldsville, Brookville, Corsica, Strattonville, Clarion, Shippensville, East Sandy, Oil City and Franklin.

CHESTER, PA.—The ordinance granting to the Philadelphia & Delaware Electric Railway Company certain franchises for the use of streets in the city of Chester was defeated in common council.

BLOOMSBURG, PA.—The corps of engineers which has been surveying the right of way for the Columbia & Montour Electric Railroad has completed its work. The road will be 25 miles long.

MARSHALL, MICH.—The Michigan Traction Company, of Kalamazoo, has filed a mortgage to secure issuance of $600,000 worth of bonds. The American Trust Company, of Philadelphia, floated the bonds.

EAST ST. LOUIS, ILL.—W. I. Mayo will apply for a franchise to construct an electric railway from the end of the Denverside branch of the East St. Louis Electric Railway to the village of Millstadt.

CLEVELAND, O.—The reports that the contracts for the building of the Port Clinton power house of the Toledo, Tiffin & Sandusky Electric Railway are incorrect. No contracts have yet been given out.

SEYMOUR, IND.—Leslie & Moore, of Indianapolis, have petitioned the City Countil for a street railway franchise, the road to connect with or form a part of the proposed line from Indianapolis through the Southern part of the State.

ST. LOUIS, MO.—The franchise asked by the St. Louis County Transit Company, asking permission to construct a road from the western limit of St. Louis through Clayton and Des Peres to the east line of Manchester, has been approved.

WASHINGTON, D. C.—The Washington Traction & Electric Company has just installed two large storage battery plants. It is stated that the company will erect a large addition to its power house on Thirty-third Street, Georgetown, D. C.

HUNTINGTON, IND.—The organization of the Huntington & Portland Electric Railway Company has been effected. Following are the officers: D. C. Dungen, of Huntington, president; J. A. M. Adair, of Portland, secretary. The capital is $50,000.

CHARLOTTE, N. C.—Returns to the North Carolina corporation commission show that only 30½ miles of street railroads are in operation in the state, all being trolley systems. Last year 2,793,742 passengers were carried, and the total receipts were $143,058.

WILMINGTON, N. C.—The Wilmington & Chester Traction Company has consented to adopt the 12-hour swing system, with wages at $1.90 for the 12 hours, an increase of 6 per cent. The old system required the men to work 18 hours one day and six the next.

AUSTIN, TEX.—Much interest is manifested in business and financial circles in Mexico, in regard to the projected street railway system in Yucatan. This system, it is stated, will be 403 miles in length. The City of Merida will be the central point of the system.

URBANA, O.—The Urbana, Mechanicsburg & Columbus Railway Company is being formed at Urbana to build an electric railway from Urbana to Columbus, a distance of about forty-five miles. The City Council of Columbus has been asked for a franchise to permit the road to enter the city.

CHICAGO, ILL.—An electric trolley line is to be constructed between Chicago and Joliet in the near future, a part of the right of way having already been secured. It is said that overtures have already been made to the drainage canal trustees to permit the track to be laid on one of the banks of the canal.

PUEBLA, MEXICO.—Electric power will be introduced on the street railway lines in this city. Negotiations are now being conducted for the purchase of a water power concession, and if the deal is consummated an electric power plant will be established near the city for the operation of the railway system.

DURANGO, MEXICO.—The project of establishing a new street railway system in this city has been revived by B. W. Regarp, a Chicago capitalist. Mr. Regarp is now in the City of Mexico organizing a company composed of Chicago and Mexican business men to build the proposed line, which will be electrically operated.

KANSAS CITY, KAN.—The car storage house and the shops of the Kansas City Elevated Railway and the west side division of the Metropolitan Street Railway Company in this city were completely destroyed by fire recently. The loss was about $60,000. Contracts will be let at once for the construction of a new building to take its place.

LOUISVILLE, KY.—At the annual meeting of the stockholders of the Louisville Railway Company the present board of directors was re-elected. The present officers were also re-elected, as follows: T. J. Minary, president; St. John Boyle, vice-president, and Samuel G. Boyle, secretary. Authority was granted to issue $2,000,000 of improvement bonds.

MOUNT PLEASANT, O.—J. A. White, of Mount Pleasant, is at the head of an enterprise which is securing the right of way for an electric road from Martin's Ferry on the Ohio river to Cadiz by the way of Mount Pleasant, and Harrisville. He has secured twenty-five year franchises through Jefferson and Belmont counties.

NEW CASTLE, PA.—At the annual election of the New Castle Traction Company, of New Castle, Pa., and the New Castle Electric Company, the following officers were elected: Hon. J. D. Cameron, president; E. E. Hamilton, secretary and treasurer; Gaylor Thompson, general manager. The board of directors is: R. R. Quay, J. D. Cameron, Gaylor Thompson.

LENOX, MASS.—The Lenox Street Railway Company has been incorporated. The capital stock is $11,250. The following are to act as a board of directors until others are chosen by the corporation: Charles Lanier and F. Augustus Schermerhorn, of New York City; William D. Curtis, Edward McDonald, William Mahanna, Isaac J. Newton and Murray A. Brown, of Lenox.

ALBANY, N. Y.—The state railroad commission has approved an application of the United Traction Company of Albany and Troy for authority to increase its capital stock from $4,000,000 to $5,000,000. The proceeds of the sale of the new stock will go toward purchasing new cars and equipment for the Troy division of the road, and to pay off $399,300 debenture bonds of the former Troy City Railway.

CLEVELAND, O.—In the suit brought by the First National Bank of New York against the Cleveland City Railway Company to recover $29,800 alleged to be due on bonds of the old cable road, Judge Dissette last Friday returned a verdict in favor of the street railway company. It was proven that assessments on the bonds had not been paid and that the bank had nothing coming.

LOGANSPORT, IND.—The question of municipal ownership of the telephone plants is still under consideration by the City Council. A committee visited Indianapolis at the invitation of the Central Union Company respecting its plant and listening to a proposition for a new franchise. It has been reported that the Central Union Company had bought the Mutual or Independent Company, but this is denied by both concerns.

AUSTIN, TEX.—The Texas legislature failed to pass the bill which proposed to impose a tax of 2 per cent. on the gross earnings of the street railway companies of this state. The passage of the bill was recommended, but the special session of the legislature came to an end before the bill could be acted upon. The same bill will be introduced at the next regular session. It is also proposed to make street railways pay a heavy franchise tax to the state.

CLEVELAND, O.—The barns and machine shop of the Cleveland, Elyria, Berea & Oberlin Electric Railway Company, at Rockport, were destroyed by fire last Saturday morning. Ten cars and four snow plows were destroyed, as well as the contents of the machine and repair shops. The loss was about $75,000, fully insured. The power house is located very close to the building which was destroyed, but as the wind was away from it, it was not very badly injured. Fortunately the company had several cars at the Elyria and Berea barns so that the service of the road will not be crippled.

THE AUTOMOBILE.

THE NATIONAL AUTOMOBILE & ELECTRIC COMPANY have begun the erection of a large plant in Indianapolis, Ind.

JAMES F. BOOGE, of Sioux City, Iowa, has asked the council of that city for a 50-year franchise to run a line of automobiles for hire.

THE WINSLOW MOTOR CARRIAGE COMPANY, of Philadelphia, has been incorporated at Dover, Del., with an authorized capital stock of $300,000.

AUTOMOBILES FOR MAIL DELIVERY.—Postmaster Van Cott, of New York, has intimated that some electric vehicle company would do well to come forward and offer a trial of its vehicles for city mail service.

AUTOMOBILE AMBULANCE.—Mr. Charles S. Howell, superintendent of the West Penn Hospital of Pittsburg, is asking for bids on an automobile ambulance, which it is the intention of the hospital authorities to adopt.

THE VICTORIA MOTOR VEHICLE COMPANY, of Indianapolis, Ind., has filed articles of incorporation. The company announces its purpose of manufacturing and selling motor carriages and vehicles of all kinds. The incorporators and directors are Victor Carman, O. M. Carman and John H. Murphy.

THE NEW YORK AUTOMOBILE COMPANY, with its principal office in Syracuse, was incorporated at Albany on March 2, to manufacture and deal in automobiles and motor vehicles of all sorts. The capital is $350,000. The directors are Herman Bartels, Louis Will, Edward N. Trump, Ernest I. White, Arthur R. Peck, Frederick D. White and John Wilkinson, all of Syracuse.

THE ELECTRIC DEVELOPMENT COMPANY, of Wilmington, Del., has been incorporated with a capital of $200,000, for the building, operating and selling of electrical and other mechanical vehicles. The incorporators are Edward T. Canby, N. G. Haughey and Gardiner W. Kimball, of Wilmington.

NEW INDUSTRIAL COMPANIES.

NEWTON ELECTRIC COMPANY, of New York City, has been incorporated. Directors: Dudley C. Newton, William J. Newton and Bernard J. Isicke, New York City. The capital is $1000.

THE MAGNET WIRE COMPANY, of New York City, has been incorporated by R. P. Manning, J. DeS. Maguire, both of New York City; R. Varley, Jr., of Jersey City, N. J.; H. M. Post, attorney, New York City. The capital stock is $250,000, and the object of the company is to manufacture magnet wire.

THE BOSTON ELECTRIC HEATING & POWER COMPANY, of Portland, Me., has been incorporated at Augusta, Me., to "deal in electric heating." Capital $300,000. The incorporators are L. E. Russell, of Framingham; G. C. Hawkins, of Boston; W. G. Webber, of Bedford, Mass.; R. T. Whitehouse, attorney, Portland.

EDUCATIONAL.

THE UNIVERSITY OF ILLINOIS.—The wide scope of instruction given at this institution is well shown in pictures in a 62-page pamphlet recently issued. The various buildings are illustrated both as to their exteriors and interiors by half-tone reproductions of photographs made by the University department of photography. The view of the engineering hall shows this to be a building of large size and modern architecture, and the mechanical and electrical laboratories are of like character. A view is given of the dynamo laboratory for direct current work. There are no less than 79 separate illustrations in the book, which is a very creditable production.

PERSONAL.

MR. SAMUEL INSULL, president of the Chicago Edison Company, has been spending the past week in New York City on business.

MR. M. S. CONNER, of the Western Electric Company, sailed for London on March 7. He will be connected with the Western Electric Company in London.

MR. THOS. A. EDISON has continued to feel the effects of his recent attack of grip, and has gone south this week for a change, his stay there lasting probably a month.

MR. GUSTAVO LOBO, formerly with the General Electric Company at Schenectady, has joined the staff of the Lachine Rapids Hydraulic & Land Company, Montreal, as assistant to the general superintendent.

MR. B. D. BROWN, of the John A. Mead Manufacturing Company, 11 Broadway, New York, has just returned from a very successful ten weeks' trip, and reports business as exceedingly good for their line of coal handling and conveying machinery.

MR. W. M. MORDEY, the English electrical engineer, who is well known in this country, has taken into partnership with himself Mr. R. A. Dawbarn, an engineer of great experience in traction, lighting and power work. The firm will be known as Mordey & Dawbarn, and consulting work will be carried on at 82 Victoria Street, Westminster.

MR. THOMAS B. WHITTED, who for some time past has been connected with the railway department of the General Electric Company at Schenectady, N. Y., has been transferred to their Denver office, to assist the manager there in looking after that class of work. Mr. Whitted has been actively engaged on railway work for some years, and has become well known in the field. He is an associate member of the American Institute of Electrical Engineers.

MR. CHAS. BLIZARD, who so long and so successfully had charge of the New York office of the Electric Storage Battery Company, has now removed to Philadelphia to become manager of the sales department of the whole company. For this larger and more responsible work his ability and experience qualify him admirably. He will give his energies to the development of the business and the opening up of new territory. The expansion of the storage battery industry during the past year or two has been enormous. Mr. Albert Taylor, who has been associated with Mr. Blizard in the New York office, has been made assistant manager there.

OBITUARY.

MR. CHARLES T. RITTENHOUSE, a former editor of the *Electrical World*, died in Denver, Colo., on the morning of Feb. 26, after a few days' illness of pneumonia. Deceased was an alumnus of Stevens Institute and Columbia University, and was graduated with high honors from the electrical engineering department of the latter institution in the spring of 1896. Immediately after leaving college he accepted the position of editor of the *Electrical World* and remained with that journal for about a year. Being in poor health he went to Montana and afterward to Arizona, where it was thought the dry air of that section would restore his health. After a few months' experience with ranch life in that wild country he came to Denver, where the climate seemed to be more beneficial. His health was apparently quite completely restored and his sudden taking-off, after an illness of about four days, was a sorrowful surprise to his parents and many friends, among whom he was held in high esteem. Mr. Rittenhouse was born in New York City on Aug. 4, 1871, and was consequently between 28 and 29 years of age at the time of his death. He was a young man of high scientific attainments, and had the promise of a successful

career in his profession. When Professor Pupin, of Columbia, was experimenting with the Roentgen rays in 1895, Mr. Rittenhouse conducted many of the experiments and took some of the first Roentgen ray pictures in this country. Deceased was a member of the American Institute of Electrical Engineers, the New York Electrical Society and other scientific bodies. Mr. Rittenhouse died a few hours prior to the arrival in Denver of his mother, who had been summoned from New York. The body was brought to the home of his parents in this city, where services were held on Saturday evening last. The many friends of the deceased in the electrical profession will deeply sympathize with his bereaved parents in the untimely end of so promising a life as was that of their son.

Trade Notes.

THE ELECTRIC APPLIANCE COMPANY, Chicago, have arranged to handle the line of Dayton fans for the season of 1900.

MR. T. J. JOHNSTON, patent attorney, located hitherto in the Park Row Building, New York, has moved his office to 66 Broadway.

ST. LOUIS ELECTRICAL SUPPLY COMPANY.—At the annual meeting of the stockholders of the St. Louis Electrical Supply Company Russell Stanhope, A. Stanhope and A. S. Doxsee were elected directors.

NEW PARTNERSHIP.—The firm of H. P. White & Co., Philadelphia, Pa., has entered into a new partnership and will now trade as H. P. White Company, Limited, with office and works at 1127 Appleton Street, Philadelphia.

THE FALCON ELECTRIC MANUFACTURING COMPANY, New York, are meeting with great success with their new fan motor, orders coming in from all parts of the world. They have just closed one order for 1000 fan motors with an English firm.

THE MORGAN ENGINEERING COMPANY has been formed in Ohio, capital $3,000,000, to manufacture hydraulic, electric, pneumatic, gas and fire machinery, including guns and ordnance. The incorporators of the company are William H. Morgan, Willis H. Ramsey, Annette S. Morgan and Edward N. Higgins.

THE BULLOCK ELECTRIC MANUFACTURING COMPANY, Cincinnati, O., has been figuring on building its own gas plant, and will interest other manufacturers near by in Norwood in the scheme. The new extension of the Bullock Company's plant is not progressing so rapidly as was expected because of the inability to get delivery of machine tools which are to be installed therein.

THE C & C ELECTRIC CO., New York, has just issued two neat booklets, A and B. The first one contains a list of some purchasers of C & C multipolar generators and motors, type "M.P.," and the other a list of some C & C electric lighting and power transmission plants. The generators and motors and plants are scattered over a good part of the face of the earth, the bulk, of course, being in this country.

THE FITCHBURG FILE WORKS report an increasing demand for their files and hacksaws among electrical manufacturing establishments and electricians. They make files of every description; also hacksaws, which they warrant not to break or shell teeth. They can produce letters and testimonials as to the quality of their files from the leading manufacturing concerns in the country. The company have been established since 1863.

THE COMMERCIAL ELECTRIC COMPANY, Indianapolis, Ind., has just issued circular No. 414 and a second edition of circular No. 410. The former relates to Commercial iron clad, type R, moderate and slow speed motors, and the latter to Commercial slow and moderate speed M.P. motors and generators. The principal features of construction of these machines are briefly outlined, and illustrations of the machines complete, and detail parts are given.

THE HOMER COMMUTATOR COMPANY, of Cleveland, Ohio, is a reorganization of F. L. Homer & Co., incorporated under the laws of the State of Ohio. The business had grown so large and so rapidly that it was felt desirable to get in more capital and extend the scope of the company sufficiently to take care of the business. Their output has been very largely increased and the company is to-day doing business all over the country. Mr. F. L. Homer retains the management of the business, and is president of the new company.

MONTAUK MULTIPHASE CABLE AT THE PULITZER FIRE.—The fire which some weeks ago caused destruction of life in the New York house of Joseph Pulitzer, the proprietor of the *World*, developed the great merits of the Montauk cable for giving timely warning in case of fire. According to the testimony of Mrs. Pulitzer and several of the servants, the alarm was first given by the bells installed upon the Montauk system, and just in time to save the lives of those in the upper rooms, as a moment later they would have been asphyxiated.

NATIONAL WIRE & CABLE COMPANY.—Messrs. David Carlin, C. C. Henry, Andrew Johnston, J. O'C. Campbell and W. J. Brennan, of Pittsburg, have applied for a charter to incorporate the National Cable & Wire Company. It is claimed by the incorporators that they will use an invention of Mr. Carlin, which will revolutionize the manufacture of cable and insulated wire. The factory for manufacturing the wire and cable will be erected as soon as possible, and the company expects to be ready to bid on some of the big cable contracts which are to be given out in the near future by the government.

MOON TERMINAL AND DISTRIBUTING BOXES are clearly illustrated and their important points are described in a circular of the Moon Manufacturing Company, 43 South Canal Street, Chicago. It is stated that this terminal head combines absolute protection from lighting, trolley, electric or any high potential current. It is also said to be a perfect seal against moisture, which is so destructive to paper-insulated cables. Among the chief points to the credit of the apparatus are its low cost of maintenance, good contracts and simplicity of testing. It possesses other features of design and construction that are worth the careful consideration of those interested in telephone construction.

STERLING ELECTRIC COMPANY, of Lafayette, Ind., have recently brought out a handsome and comprehensive catalogue of their telephonic apparatus designed for all classes of service, including switchboards, sectional boards, drop parts, cross connection and distributing boards, protective devices, pole top terminals, etc. One of the most striking and interesting features of the catalogue is the list of about 200 exchanges where the Sterling apparatus, designed and patented by Mr. Frank B. Cook, has been installed, in a great many instances replacing other makes. Mr. Cook is an old Bell telephone man and follows out the ideas and improvements suggested by 17 years' experience in that service.

THE WESTERN ELECTRICAL SUPPLY COMPANY, of St. Louis, report that their trade in line and central station supplies has been especially gratifying, and that the demand for their Moloney transformers and A. B. solid copper-cased enclosed arc lamps has grown so they can hardly take care of their orders. These are products for which they are exclusive territorial agents, and which they are in a position to guarantee in every way. They assert that they are now carrying probably the largest and most complete line of electrical supplies in the country and are prepared to equip central stations, street railways and telephone lines and exchanges complete. They are prepared to supply "Everything Electrical" in all that the term implies.

THE CINCINNATI MILLING MACHINE COMPANY have just completed another building. This is the fourth addition this company has made to its original plant and it is asserted that this concern is now the largest of its kind in the world, judged by the amount of shop space used and the number of hands employed for the exclusive manufacture of milling machines. Money prizes are paid at regular intervals for the best suggestions offered for the improvement of the plant and its product. Dividends are issued every quarter to its wage earners. This company will have several exhibits of considerable importance at the Paris Exposition, one at Champ de Mars and another, of machines in full operation, in the American Machinery Building at Vincennes.

THE CHICAGO BELTING COMPANY, of Chicago, manufacturers of the old and well known brand of "Reliance" leather belting, has recently been filling some extensive contracts for various southern points. Among other mills that the company has recently fitted up are the R. L. Trigg Lumber Company's plant at Noble, La.; the Kingston Lumber Company's plant at Anniston, Ark.; the Gifford Lumber Company's plant at Gifford, Ark., and another sawmill in Tennessee. Business has been coming in at such a lively rate recently that Manager E. H. Hall says the company has found it necessary to enlarge its manufacturing facilities in Chicago, providing for an increase in output of 20 per cent., which will enable it, to some extent at least, to keep pace with the orders.

Record of Electrical Patents.

UNITED STATES PATENTS, ISSUED FEB. 27, 1900.

[Conducted by Wm. A Rosenbaum, Patent Attorney, Times Building, N. Y.]

644,050. MANUFACTURE OF LEAD PEROXID AND ITS APPLICATION TO ELECTRICAL STORAGE BATTERIES; H. Beckmann, Witten, Germany. App. filed Dec. 9, 1899. (See Current News and Notes.)

644,051. CONTROLLER FOR ALTERNATING CURRENT CIRCUITS; E. J. Berg, Schenectady, N. Y. App. filed Oct. 11, 1899. (See News and Notes.)

644,072. AUTOMATIC GRAVITY CUT-OUT FOR ELECTRICAL CIRCUITS; W. Hanlon, Poughkeepsie, N. Y. App. filed June 20, 1899. A series of pivoted jaws, each carrying a fusible strip, is adapted to swing across a pair of terminals so as to bring a new strip into the line when another has been melted.

644,094. ELECTRICAL BOND FOR RAILROAD RAILS; J. M. Price, Philadelphia, Pa. App. filed April 23, 1894. The bond is a flanged plate engaging the tread of both rail sections.

644,108. CONTACT DEVICE FOR CONDUIT ELECTRIC RAILWAYS; C. F. P. Stendebach, Leipsig, Germany. App. filed Sept. 28, 1899. A contact disk is oscillated to make contact as soon as the front end of the car reaches it and to break the contact as soon as the rear end of the car passes.

644,128. AUTOMATIC CONTROLLER FOR ELECTRIC COMPRESSORS; N. A. Christensen, Milwaukee, Wis. App. filed Sept. 2, 1899. This device consists of a movable contact having a fluid-pressure-actuating connection, maximum and minimum pressure contacts arranged to co-operate with the movable contact, a switch in the compressor-motor circuit, two magnets having circuit connections, so arranged that when said movable contact engages the maximum-pressure contact the switch will be opened and the compressor stopped, and when it engages the minimum pressure contact the switch will be closed and the compressor started, and a spark arrester arranged to be thrust between the contacts of the switch as soon as they are separated.

644,143. ELECTRIC GAS LIGHTING CANDLE BURNER; R. N. Noyes, Haverhill, Mass. App. filed April 10, 1899. The invention consists in adapting one electromagnet and armature to bring a catch in contact with a pin attached to the spindle of the gas valve to let on the gas and at the same time to separate two electrodes to create an igniting spark.

644,144. CONNECTING PLATE FOR STORAGE BATTERIES; H. G. Osborne, Chicago, Ill. App. filed Feb. 17, 1899. The connecting lug is made separate from the plate and extends down into the solution where it joins with the plate by rivets.

644,160. ELECTRIC GLOW LAMP; W. Boehm, Berlin, Germany. App. filed Feb. 2, 1899. (See Current News and Notes.)

644,204. SWITCH BOX FOR INTERCOMMUNICATING TELEPHONE SYSTEMS; A. K. Keller, Philadelphia, Pa. App. filed July 1, 1897. Details of construction of the subscriber's box in an automatic exchange system.

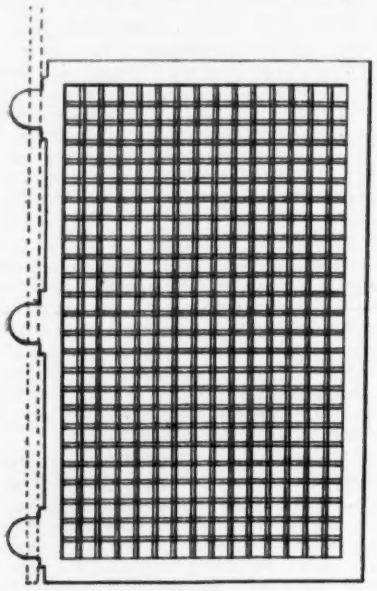
644,205. TELEPHONE TRANSMITTER; A. K. Keller, Philadelphia, Pa. App. filed Aug. 20, 1898. (See Current News and Notes.)

644,206. TELEPHONE RECEIVER; A. K. Keller, Philadelphia, Pa. App. filed Aug. 20, 1898. (See Current News and Notes.)

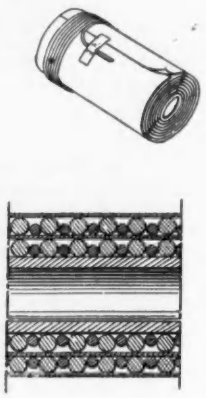
644,251. ELECTRIC CONTACT APPARATUS; C. G. O. H. von Köhler, Stockholm, Sweden. App. filed Dec. 5, 1898. This is a sealed tube having a pair of contacts at one end and a free globule of mercury with means for tilting the tube comprising strong and weak springs acting in opposition.

644,278. MEANS FOR REGULATING ELECTRIC MACHINES; W. H. Cooley, Brockport, N. Y. App. filed March 9, 1899. A supply circuit, an electromotive force generator connected across the terminals thereof, a translating device, and means whereby the translating device may be variously connected across the terminals of the supply circuit in series with any desired portion of the generator and in parallel with the remaining portion thereof.

644,311. METHOD OF WINDING HELICES FOR ELECTRICAL PURPOSES; J. C. Anderson, Jersey City, N. J. App. filed June 15, 1899. According to this method of winding, bare copper wire is wound alternately with silk thread in each layer and the superposed layers are separated and insulated from each other by interposed individual sheets of paper.



644,144.—Connecting Plate for Storge Batteries.



644,311.—Method of Winding Helices for Electrical Purposes.

644,312. ELECTRICAL HELIX; J. C. Anderson, Jersey City, N. J. App. filed Aug. 29, 1899. This is the product made in accordance with the method described in the preceding patent.

644,315. TELEPHONIC RELAY; F. H. Brown, Oak Park, Ill. App. filed Nov. 27, 1899. (See Current News and Notes.)

644,330. ELECTRICAL MEASURING INSTRUMENT; J. W. Packard, Warren, Ohio. App. filed Jan. 12, 1900. This instrument comprises a core arranged to revolve about an axis, and a flattened solenoid coil arranged spirally about the axis, the core standing normally at one end of the coil and being adapted to move towards the other end of the coil under the influence of the solenoid when energized.

644,357. MULTIPLE FUSE CUT-OUT; J. B. Hubbard and C. J. Dorsey, Baltimore, Md. App. filed Oct. 28, 1899. A disk carrying a number of fuses, each electrically and mechanically separated and protected by surrounding non-conducting material and having spring contact plates arranged on the periphery of the disk and arranged to engage successively a pair of stationary contacts.

644,370. APPARATUS FOR ADJUSTING ELEVATION OF GUNS; G. A. Schoeller, Mulheim-on-the-Ruhr, Germany. App. filed Nov. 29, 1899. According to this invention electrical connections are arranged between the index hand, its plate and the index curve which permit the gunner to see whether the gun is turned to the proper elevation, the invention being an improvement upon that described in a previous patent.

644,407. AUTOMATIC REGULATION OF SYSTEMS OF ELECTRICAL DISTRIBUTION; J. L. Creveling, New York, N. Y. App. filed Oct. 28, 1899. In a system of electrical distribution a generator, a storage battery in circuit therewith, a lamp or consumption circuit into which both the generator and battery are adapted to deliver current, a variable resistance in the lamp or consumption circuit and electromagnetic means connected to the generator main circuit and to the battery for increasing the resistance in the lamp or consumption circuit upon a decrease of current from the battery to the lamp or consumption circuit.

644,408. CAR LIGHTING SYSTEM; J. L. Creveling, New York, N. Y. App. filed Oct. 28, 1899. In a system of electrical distribution containing a dynamo and storage battery and wherein the dynamo is liable to have its direction of rotation reversed, a pole changing device adapted to control the circuit, positive transmission means intervening between the rotating armature and the pole changing device and electromagnetic means in circuit with the dynamo for breaking the mechanical transmission.

644,409. ELECTRICAL DISTRIBUTION; J. L. Creveling, New York, N. Y. App. filed Oct. 28, 1899. In this system there is included a generator, a storage battery to be charged thereby, an electromagnetic switch in the generator circuit, a shunt field coil, an opposing field coil in the battery circuit, a battery shunt field coil, a variable resistance in series with the last and means operated by the fluctuations of the current of the generator for varying the amount of resistance in circuit with the battery shunt field coil.

644,448. CIRCUIT CLOSER FOR TELEGRAPH KEYS; E. E. Nye and L. C. McIntosh, Los Angeles, Cal. App. filed Oct. 28, 1899. A rubber band is employed and so arranged that whether the first or second finger is used on the key knob it will assist in holding that finger on the key.

644,497. WIRELESS TELEGRAPHY; A. F. Collins, Saratoga Springs, N. Y. App. filed Nov. 7, 1899. (See Current News and Notes.)

644,510. PROCESS OF ELECTRICAL REDUCTION; E. F. Frost, Washington, D. C. App. filed Nov. 21, 1899. (See Current News and Notes.)

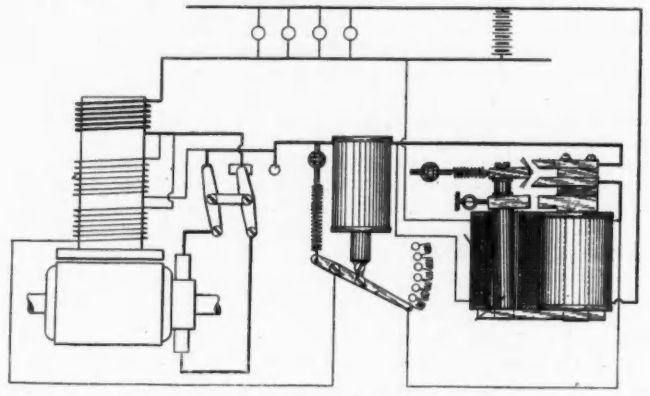
644,538. VOLTAIC CELL; A. Pfannenberg, Berlin, Germany. App. filed April 15, 1899. (See Current News and Notes.)

644,551. ELECTRIC SIGNALING APPARATUS; G. Harris, Detroit, Mich. App. filed Aug. 6, 1898. Details of construction of a station box.

644,552. ELECTRIC METER; G. Hookhan, Birmingham, England. App. filed Sept. 12, 1899. The meter comprises a pendulum, a shunt coil carried thereby, a series coil co-acting with the shunt coil, a recording wheel train, reversible connections from the pendulum for operating the train and means for automatically reversing the connections at determined intervals.

644,553. APPARATUS FOR CONVERTING ALTERNATING INTO CONTINUOUS CURRENTS AND VICE VERSA; M. Hutin and M. Leblanc, Paris, France. App. filed June 19, 1899.

644,554. ELECTRIC RECUPERATOR; M. Hutin and M. Leblanc, Paris, France. App. filed June 19, 1899.



644,409.—Electrical Distribution.

644,555. PROCESS OF REDUCING THE APPARENT INDUCTANCE OF ELECTRICAL CIRCUITS; M. Hutin and M. Leblanc, Paris, France. App. filed Dec. 26, 1899.

644,561. MICROPHONE; E. B. Fahnestock, Washington, D. C. App. filed March 1, 1899. (See Current News and Notes.)

GERMAN PATENTS, ISSUED FEB. 14, 1900.

[In Charge of Dr. Ralph Julian Sachers, 120 Liberty Street, New York.]

105,943. ARC LAMP FOR POLYPHASE CURRENTS; K. Wilkens, Berlin. App. filed Dec. 1, 1898. The lamp is provided with three carbons, two of which are connected to levers forming parts of segmental gears, the third carbon being fed by a screwed spindle carrying this carbon and operating the segmental gears. There are thus three single arcs produced. In order to increase the light efficiency, bodies of rare earths or of metal oxides may be interposed between or immediately above the arcs.

106,152. SELF-ACTING TRANSFORMER SWITCH; Alfred Schlatter and Geza Szuk, Budapest. App. filed Oct. 19, 1895. This switch has for its purpose the automatic throwing in and out of transformers as the throwing in and out of translating devices takes place. The device prevents shocks which may be produced by a too sudden release of the switch lever from the electromagnet. An auxiliary magnet is used for this purpose, the switch lever of which carries a clutch engaging and holding the lever of the first mentioned magnet. On the circuit of this second magnet a resistance is provided, for instance, an incandescent lamp, the value of which decreases on account of its becoming heated, whereby a gradual increase in current is produced in its circuit, and a gradual attraction of the armature of the magnet.

106,444. TIGHTENING DEVICE FOR TELEPHONE DIAPHRAGMS; W. H. Vollenbruch, Goerlitz. App. filed April 27, 1898. An annular ring, moved by a worm screw arrangement, engages a number of lamelar segments, the outer periphery of which decreases or increases in diameter and thereby tightens or loosens the diaphragm.

106,817. DIFFERENTIAL ARC LAMP; G. Schemalleck, Tangermunde. App. filed April 12, 1899. Two rollers carrying the carbon holder chain are fastened to two standards of a frame supported by the solenoid cores of two coils. One of the coils is in series, the other in parallel in the main circuit, and, therefore, the movement of the two rollers is independent of each other.

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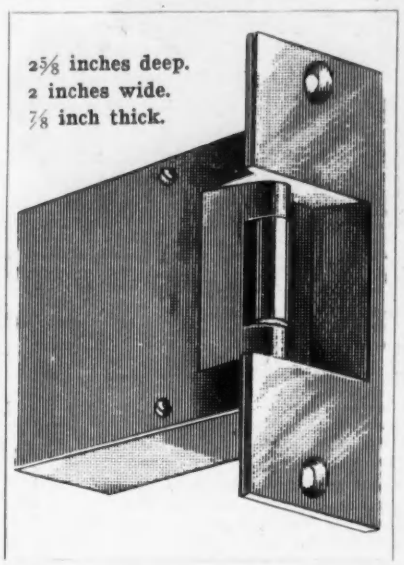

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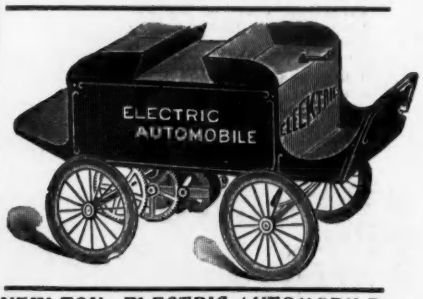

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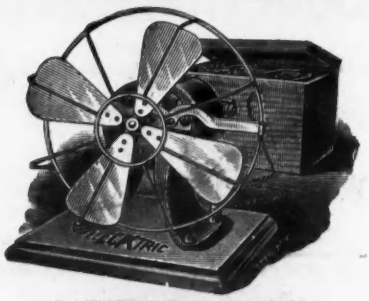

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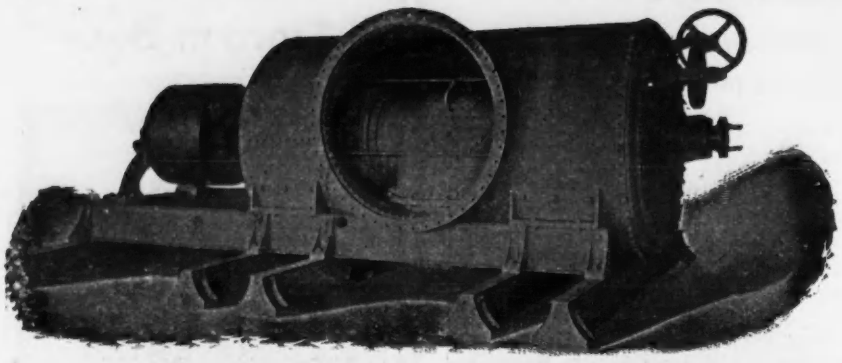

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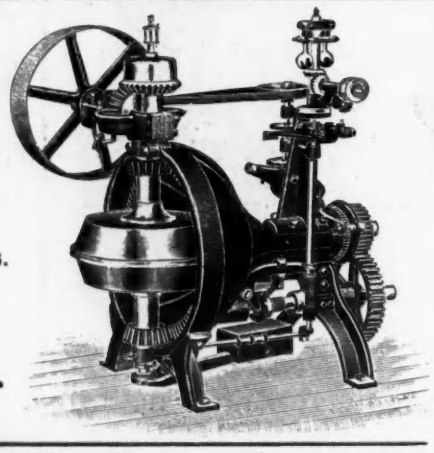

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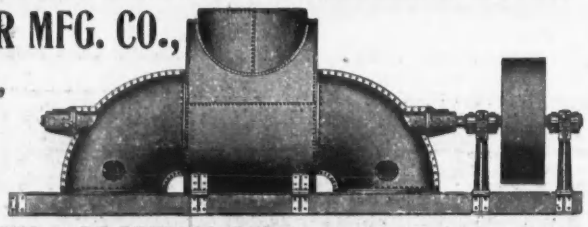

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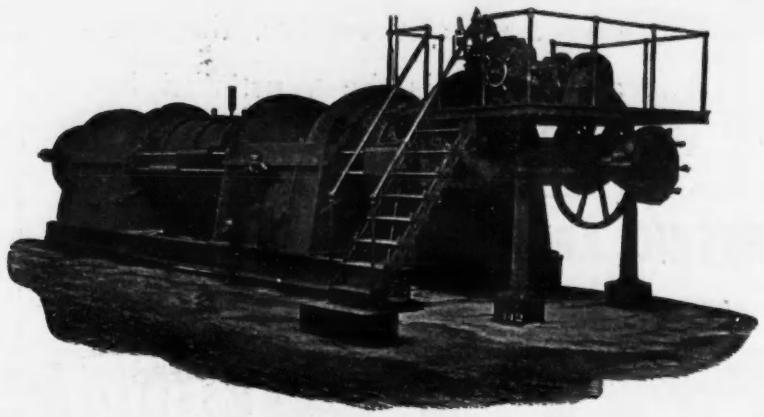

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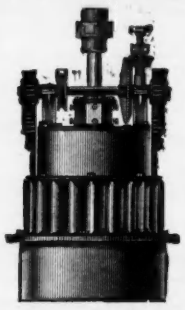

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